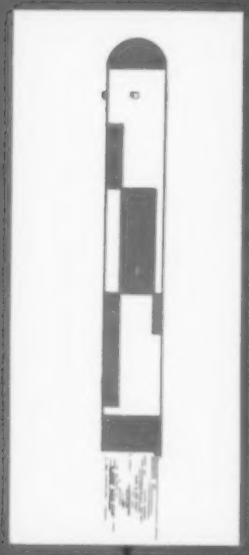
JUNE 16, 1958 PRICE 50 CENTS

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

RESEARCH and DEVELOPMENT news edition

Industry Eyes Polaris Planning



Control Project HALVES

Polaris Development Time . . .

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E B POWER GS L
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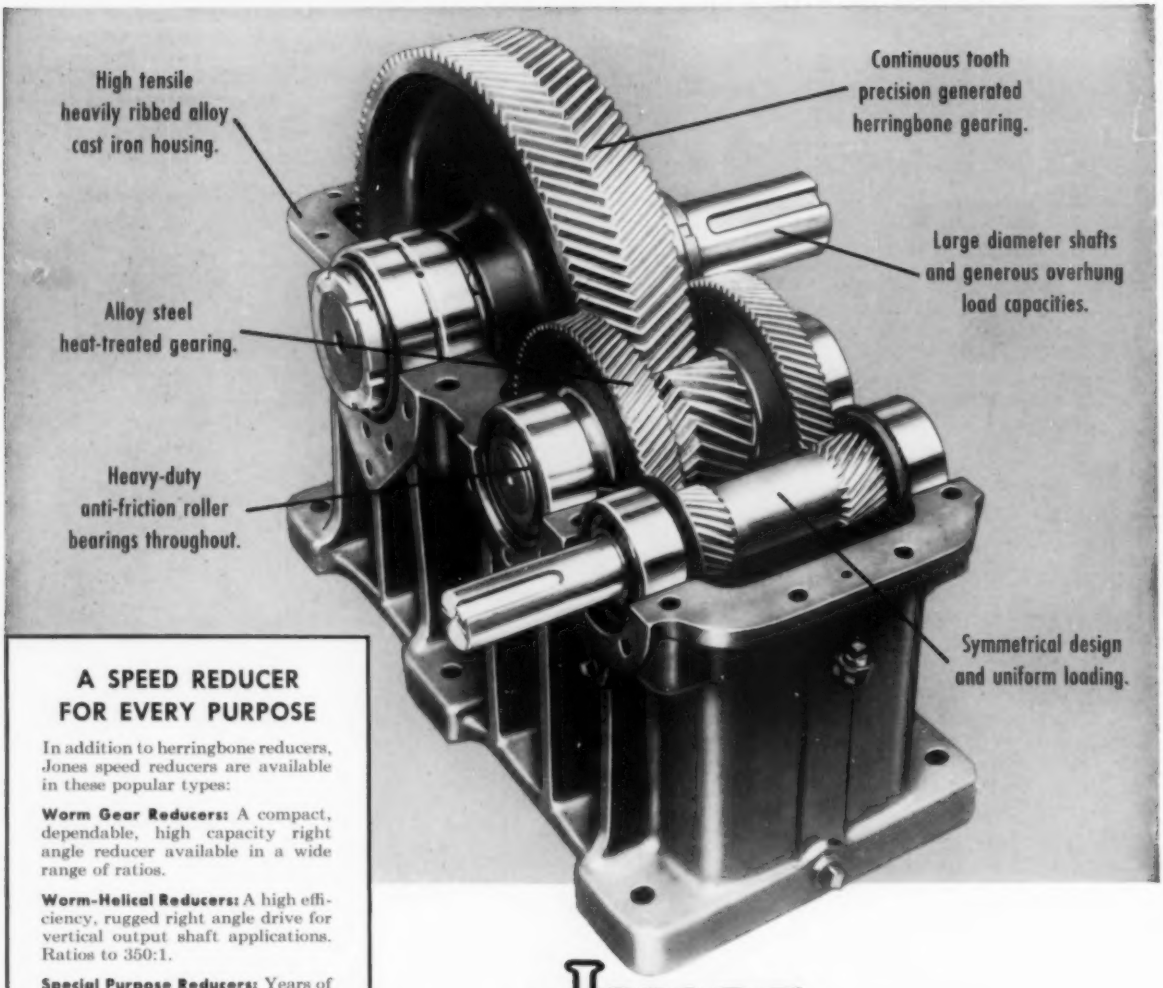
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watch for

the R and D edition

for June 30

Read the viewpoints
of 5 top American educators on

Must the U. S. compete with Moscow in an education race?

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of the U. S.

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The Saturday Review

coming next week . . . the DESIGN edition for June 23

FEATURING:

- **Design for automatic production**

  Three case histories show the value of designing a product and the machine to make it at the same time. Examples reveal methods for automating moderate or even small production quantities.

- **How to predict wear of metal parts**

  Calculate the effects of galling, poor oil, dust, surface cracks.

- **Control enclosures that meet industry standards**

  What standards apply? Here's a working guide for the designer.

- **New high-speed molding process cuts rubber part costs**

  How it works and how to design parts for it.

- **European solder developments**

  A roundup of metal-joining advances.

- **For better electroplating**

  Nine hints on how to mount, drain, specify radii.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news edition

June 16, 1958 Vol. 29, No. 24

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Research and Development news edition

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● **Engineering personnel selection policies** are in for some serious revision, particularly if management wants creativity as much as it claims (p. 30). We hear from France that Charles Heurtey of Heurtey et Cie., a large engineering firm, evolved a beautifully simple personnel policy. Men are stupid or brilliant, lazy or energetic, he says. What are the possible combinations? The stupid-lazy man is worst, avoid him like the plague. The stupid-energetic man will destroy your organization with his misdirected interests. Even the brilliant-energetic man will raise havoc in a closely knit company. He has too many irons in the fire and can't stick to one long enough to make something practical of it. You should hire the brilliant but lazy man. He has the ideas, the ability and, most important, a burning desire to get things done and out of the way so that he can relax and enjoy life.

● **Fully mature products** somehow always turn out to be vest-pocket-size. Clocks became watches, radios were reduced to the size of a pack of cigarets, and now we have a personal desk fan as sleek as a jet plane (p. 24). It is no trick to foresee the future of many other familiar gadgets: One-man air conditioners no bigger than a 35mm camera, personal telephones that strap to your wrist, a TV screen that unrolls like a window shade. Even small autos are becoming fashionable and, who knows, they may eventually shrink enough to fit the garage!

● **"Learn to delegate responsibility** and you're half way to becoming a good manager." At least that's what we're told, and the military seem to be making it work (p. 17). Last month C. E. Paules, vice-president of Esso Research and Engineering offered a thoughtful reminder, ". . . no one relieves himself of his own responsibility by delegating to others. Responsibility . . . multiplies as it is passed along and leaves the greater part in the hands of the giver. If anything goes wrong in the work of an engineering department, the *top man* bears the responsibility . . ."

ABP JUNE 16, 1958 **Product Engineering** *A McGRAW-HILL PUBLICATION* Vol. 29, No. 24 ABC

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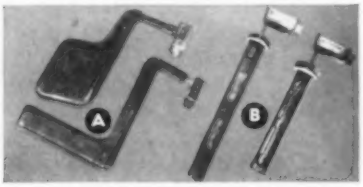
How to select cast-in immersion Heaters for Metal Melting Applications

Here is condensed information to help you get the most economical electric heater for any design problem where melting soft metals is a factor.

General Electric cast-in immersion heaters can be applied to virtually any process machine which uses soft metals in a molten state.

Two factors generally determine which General Electric cast-in immersion heaters should be used. They are: the physical characteristics of the machine or pot, and the temperature required.



"Over-the-side" immersion heaters (a), as their name implies, are merely suspended in the pot or crucible with their effective heating portions immersed directly in the metal. Installed in this manner, these heaters can be easily shifted to vary the heat distribution as required. Furthermore, these heaters can be added or replaced without shutting down the bath.

"Through-the-side" immersion heaters (b) are designed for relatively permanent mounting on the side of the crucible or pot by means of a gasketed flange header. This type of heater is best suited to smaller pots because of its relatively small radiating surface.

To figure the amount of heat required for your application:

1. Determine weight in pounds of the metal to be heated. (Volume of the pot in cubic feet x weight of metal in pounds per cubic foot from Table II.)

2. Determine operating temperature of metal bath from Table II.

3. Using the data obtained in Steps 1 and 2 above, read kilowatt hours from Table I.

4. Divide the answer obtained in Step 3 by the hours allowed for heat-up. You now know how many kilowatts of heat are required for your installation.

For complete information on sizes and ratings of General Electric heaters, call your General Electric Apparatus Sales Office or send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

TABLE II METAL MELTING DATA

Metal	Wt in Lb per Cu Ft	Melting Temperature in Deg F	Heat Required to Melt 1 Lb		Watt-hours Required to Heat 1 Lb 1 F from Melting Temp.	Usual Operating Temp. in Deg F	Watt-hours Required to Bring 1 Lb to Working Temp.
			Btu	Watt-hours			
Lead	710	620	28	8.3	0.0098	725	9.2
Tin	455	450	47.5	14.0	.0187	600	16.7
Solder (1 part tin, 1 part lead)	555	400	33	9.6	.0152	650	13.8
Solder (2 parts tin, 1 part lead)	520	365	38.8	11.4	.0171	520	13

TABLE I TO DETERMINE KW HOURS

Weight in Lb	Solder (2 Parts Tin, 1 Part Lead)			Solder (1 Part Tin, 1 Part Lead)			Tin			Lead		
	470°F	520°F	570°F	600°F	650°F	700°F	550°F	600°F	650°F	700°F	725°F	750°F
	KW Hours			KW Hours			KW Hours			KW Hours		
100	2.3	2.4	2.5	2.3	2.4	2.5	2.7	2.8	2.9	2.5	2.6	2.7
500	9.3	10.0	10.7	9.6	10.1	10.7	11.5	12.0	12.5	4.7	5.2	5.7
1,000	18.3	19.3	20.3	18.6	19.7	20.8	22.5	23.5	24.5	18.1	19.1	20.1
1,500	25.5	27.0	28.5	33.7	35.2	36.7	32.0	33.5	35.0	23.9	25.4	26.9
2,000	38.0	40.2	42.5	46.5	48.5	50.5	47.0	49.0	51.0	33.0	35.0	37.0
2,500	46.0	48.0	50.2	54.0	57.0	59.5	56.0	58.5	71.0	44.3	46.8	49.3
3,000	52.0	56.0	60.3	61.3	64.6	67.8	66.0	70.0	74.0	50.0	53.0	56.0
3,500	60.0	64.0	68.5	68.7	72.4	77.0	75.0	79.0	83.0	56.0	59.5	63.5
4,000	67.0	71.5	76.5	76.5	80.7	85.0	84.0	89.5	94.5	62.0	66.5	70.5
4,500	75.0	81.0	87.5	83.5	89.0	95.0	94.0	100.0	105.0	68.0	73.0	78.0

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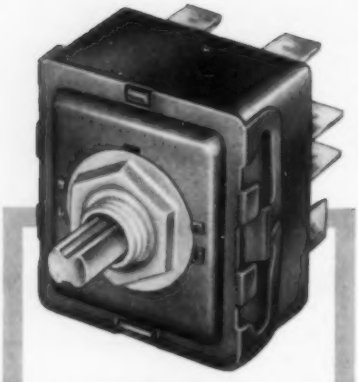

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SWITCHES

Versatile circuitry of "Diamond H" Rotary Switches is one reason they're found on leading makes of window air conditioners. Single or double pole, with capacities far greater than their size suggests and from two to 12 positions — with or without stop — they are also used to control motor starting and reversing as well as resistive circuits in a variety of other applications.

UL approved ratings range to 25 A. at 120/240 V., to 1 H.P. at 120 V. and 2 H.P. at 240 V., A.C. Bases, however, measure only 1½" x 1¼" x ⅞". Spade or screw terminals. Spindles may be extended to permit ganging of mechanical or electrical controls.

For a quick run-down on "Diamond H" switches, relays, thermostats and other devices, send for a free copy of the "Diamond H" Check List of Reliable Controls.

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READER TO EDITOR

Engineers Can Make Good Executives

To the Editor:

Your news report, "Equation: Good Engineer Equals Bad Executive," (May 12, p. 21) implies that a good engineer cannot be a good executive. Many engineers make good executives, however, just because a man is a good engineer does not mean that he will be a good executive. The point is that the aptitudes required of a good executive are not all concurrent with those required of a good engineer.

—Floyd L. Ruch, PhD
President
Psychological Services, Inc.
Los Angeles, Calif.

Lonely Stand

To the Editor:

Your two contributions to the March 17 issue, "For Want of a Nail . . ." and "The Little Things" pleased me enormously (pp. 65 and 134). In the old days before the New Deal, if a management didn't have enough sense to turn out something that people would buy for money, the stockholders threw them out and got some other managers. The business of running to Capitol Hill and yelling, "We're too stupid to earn money, the government must give us some," does not set well on my stomach.

However, in the same issue to which I refer there are indications that we are likely to be lonely in our stand. On pages 58-59 your boss, Donald C. McGraw, says: ". . . business has the opportunity, through advertising and other selling efforts, to help sustain a high level of economic activity." Don't give them anything for their money . . . just *sell* them.

A headline on page 23 says, "Detroit Designers Not Hit by 13-yr Job Low," and the story says, ". . . Apparently manufacturers are turning to designers in an effort to dress up their products for added appeal in the shrinking buyers market . . . staff members in engineering . . . are being quietly let go." On Page 22: "US Cars Losing Favor in Europe." All this is quite interesting.

Recently the handle of the hand brake in my 1954 Chevrolet station wagon came off in my hand because the crossbar of the T handle was spot-welded on with a full ¾" diameter of spot.

A depression is the time when the last dupe has been swindled of his last dollar. Madison Avenue has done just about that. This is an Alec Osborne depression. Nothing could be more typical of the attitude you and I both deplore than the "brainstorming" approach—never let anyone ask if what you say is sensible or true—just say a lot, and make it sound attractive.

—Henry William Kaufmann
Mont Clare, Penna.

Less Car Value For More Money

To the Editor:

Mr. Richard A. Pearl's letter in your May 12 issue is quite appropriate in revealing some of the sharp practices of the car makers. Although they are not publicized, there are many such examples of the well-known "brush-off" by car makers to legitimate complaints. With the 1958 car season well along now, many prospective car buyers are asking if the new cars will have any noticeable improvement in quality and workmanship. Despite all the fancy new car styling, despite the car makers' mania for more and more horsepower, and other useless gimmicks, many people will be looking for some relief from the aggravation of repeated expense and loss of valuable time in having numerous factory-built defects repaired after the new-car guarantee is up.

It's no secret to the garage mechanics who prepare new cars for delivery to car buyers that there has been a sharp increase in shoddy workmanship and sloppy assembly methods in many auto assembly plants. The result of this growing cancer of the auto industry is the harsh fact that we have been getting less and less actual car value for more and more money. Today with new car sales at an all-time low, it is not surprising that many people are going to think twice about buying a 1958 car until they feel that they will get somewhere near their money's worth in more car quality and noticeably better workmanship.

—R. Blagden
East Hampton, Conn.

American... DEVELOPMENTS TO WATCH...

Plastics can stand ultrahigh temperatures . . .

. . . even better than many inorganic materials, say recent research reports.

Materials specialists at GE's Missile and Ordnance Systems Dept. describe tests at 4500 F in which reinforced plastics hold up at least as well as the refractory metals. At 15,000 F, they say, the plastics—particularly the phenolics—are superior. Furthermore, phenolics reinforced with nylon fibers do better than those strengthened with glass or asbestos. It may be the high specific heat of the hydrogen in the synthetic fiber delays final breakdown of the material.

Likewise, Walter Brenner and C. J. Marsel of New York University, reviewing materials for high-temperature use, told a recent Chemical Engineering Conference (*PE*—May 5, p. 16) that burn-through tests of fiber-reinforced phenolics at 4500 F "showed these materials to outperform a plate of steel of equivalent thickness by a factor of more than 3 to 1."

"Heavy" rubber, made with the same . . .

. . . hydrogen isotope that creates "heavy water," offers unique properties that could lead to marked improvement in the quality of rubber products. Researchers at Goodrich-Gulf Chemicals who synthesized this unusual material say it's more rubbery than the natural product, and exhibits good tensile qualities even without carbon black reinforcement.

Heavy rubber is not likely to be a commercial product—now or in the future. Heavy hydrogen (deuterium) is far too expensive for that, though it is a naturally occurring isotope. But it might some day be used for a few special applications.

As to why the heavy rubber is more "rubbery," Goodrich researchers believe deuterium-containing molecules attract each other less strongly than those in normal rubber, providing a more fluid material.

$4 billion question . . .

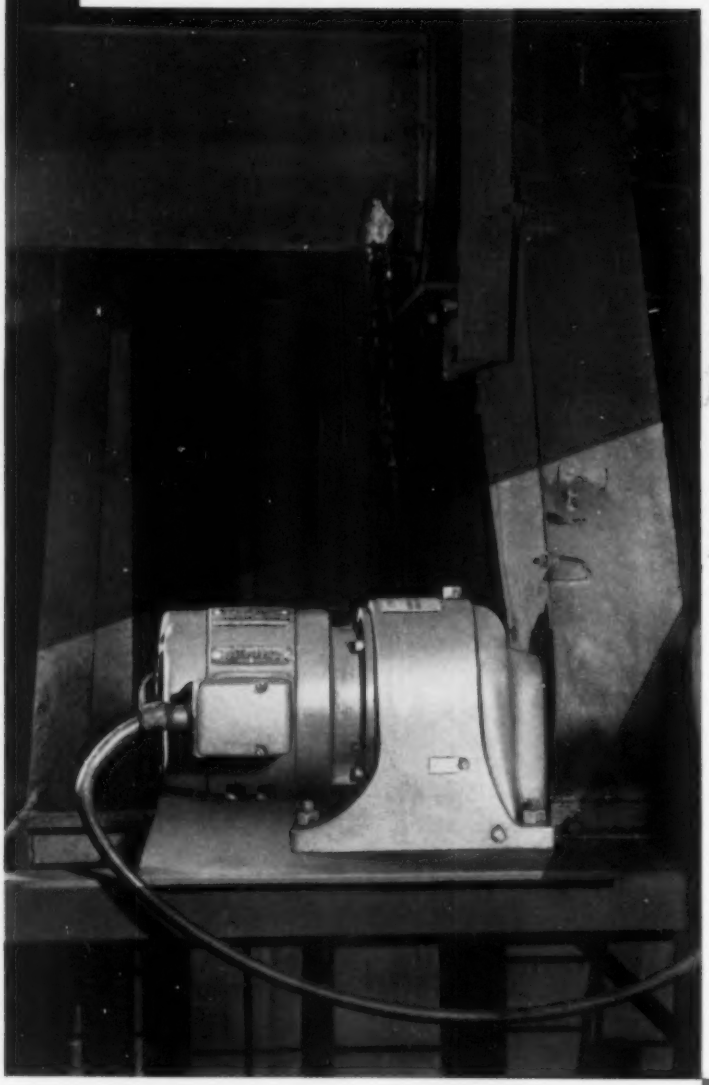
. . . in the home appliance field is whether tomorrow's buyer will want built-in or free-standing units. Kelvinator, in introducing its dual line for 1958, said present demand favored the free-standing unit; but believed the future would see a strong swing toward built-ins. On the other hand, Youngstown Kitchens is betting its chips on self-contained, free-standing "furniture-type" equipment that the customer can move around at will.

Youngstown vice-pres. M. L. Ondo believes the mass market lies in self-contained simple units priced in the $500 to $1,000 range. "It's no trick," he says, "to design a $20,000 kitchen and then build a house around it. The trick, it seems to us, is to build a kitchen that can fit into any house, at a price Mr. and Mrs. America can afford to pay."

Meanwhile, though, makers of smaller appliances are finding plenty of new design opportunities in supplying the consumer who wants in-the-wall equipment. One company, for instance, has a whole line of "electrical built-ins for homes," including a food-service center, fan-equipped range hoods, and the bathroom scale pictured here. Westinghouse, too, offers "service center" control units, and other devices of this type are being readied for market. —ARG

Built-in scale illustrates one company's faith in the market for built-in appliances—small ones at least. Made by Nutone, Inc., it carries a $34.95 price tag ($49.95 in aluminum), seems to be selling well.

Tight space? Perfect place for a Link-Belt Gearmotor



Maintains life-long alignment with flange-mounted NEMA motors

Here's a speed reducer right in step with industry's campaign for higher productivity in less space. Because its gear trains incorporate a minimum of parts . . . because its motor is directly connected to the gear drive with a flange—the Link-Belt Gearmotor is the ultimate in compactness.

Imagine how these same features cut costs. The flange connection eliminates additional coupling devices. Simple gear trains have fewer parts to wear, to service, to invite trouble.

You'll find them in Book 2447. Call your nearby Link-Belt office.

LINK-BELT

SPEED REDUCERS

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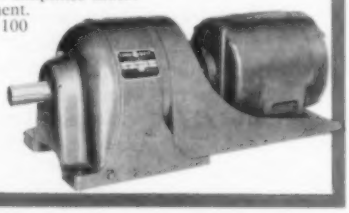
LINK-BELT MOTOGEAR—for bracket-mounting all makes and enclosures of foot-type NEMA motors — simplifies motor replacement. Sizes to 100 hp.



American ...Washington

DEVELOPMENTS TO WATCH...

The military may tighten its grip . . .

. . . on new weapons development. The Pentagon is taking a long hard look at the highly touted "weapon system management" scheme. Observers guess that the plan will be shaken down some, that new limits will soon be clamped on the powers of prime contractors over missile or aircraft projects run under weapons system management.

Under this scheme, control over a weapons development or production project is centralized in one prime contractor—with a minimum of government interference. He has responsibility for the design and production of an entire system and components.

The method was conceived as a means of simplifying and speeding development of the more complex new supersonic planes and missiles.

Now, many Defense Dept. officials are having some second thoughts. They complain that the services have "abdicated control" over projects to the primes and that, as a result, development costs have mushroomed. Their chief gripes: that many weapons system primes are duplicating each other's ground support equipment and important components.

New ground rules for regulation . . .

. . . of small business rate a better than even chance. Congress has told the Small Business Administration for several years that it wants more flexibility in labeling a company as large or small.

The legislators claim that SBA has not done this. So Congress is out to change the law. Basically, here is the situation. Congress, and much of industry, argue that SBA relies heavily on the number of employes a company has to classify it as small or large business. They object to this emphasis.

Congress wants less emphasis on the number of workers and more on such factors as whether the company is dominant in its field, independently owned, etc. And, despite SBA assurances that this is given consideration, Congress wants it spelled out more strongly in the Small Business Act.

Last year, the House of Representatives approved the change. Now, the measure is before the Senate. And indications are that the Senate will most likely sanction any change made in the current law.

Government is going all out to spread work . . .

. . . to depressed labor areas. This June 17 to 19, a giant-size "business opportunities" exhibit will be held at Huntington, W. Va. Another such fair is scheduled for Hartford, Conn., on July 9-11. Similar exhibits were held earlier at Los Angeles, East St. Louis, Albuquerque, and Port Huron.

The Huntington exhibit will be biggest to date. The Government estimates that $90 billion worth of contract opportunities will be on display. It is spending over $100,000 to set up the show.

The fair is a two-part matter. Companies show their production and research and development capabilities; the Government agencies and major prime contractors show equipment with specifications that they are seeking subcontractors for.

Nothing is for sale; main purpose is to spark contract bidding. Experienced procurement personnel are on hand to discuss contracts with interested companies.

Main backer of the exhibits is the Department of Defense. It claims that such fairs in the past have been highly successful in spreading new contracts.

Design engineers may get a chunk of business . . .

. . . from the railroad industry. Recently, Congress took the first step toward helping that industry modernize its equipment.

There are Congressional hurdles still to be cleared, but the way seems to be paved toward government guaranteeing up to $700 million—on a revolving fund basis—for new equipment.

In addition, the legislators want to give the railroads more leeway in abandoning service on unprofitable lines, and more freedom in rate making.

World-wide ...

DEVELOPMENTS TO WATCH...

The Russians are turning to "protective vacuums" . . .

. . . for producing high-strength powder metal parts, reports Dr. H. H. Hausner, US powder metallurgy expert and atomic energy consultant.

Powders with large percentages of such metals as aluminum tend to oxidize rather readily in "ordinary" vacuums. But, the Russians say, pressures on the order of 1 micron at 2550 F provide a sintering atmosphere in which only hydrogen and argon molecules exist, and in which oxygen is said to be "completely eliminated."

This information came from behind the Iron Curtain in an oddly roundabout way:

Dr. Hausner had discussed sintering of uranium oxide compacts in inert atmospheres in a paper prepared for a Symposium on Rare Metals, sponsored by the Atomic Energy Commission of India. That was last December. A few weeks ago, a letter from Bombay disclosed that in commenting on Dr. Hausner's talk, Russia's Prof. Mozhukhin had dropped the information reported here.

Chromium metal parts for service at 1700 F . . .

. . . can be produced, metallurgists at the Australian Defense Standards Laboratories believe, by controlling the processing method as well as the impurity content of this heat-resistant but generally brittle metal (*PE*—Mar. 17, p. 66). By melting the metal in a special inert-atmosphere arc furnace, and then extruding it at very slow rates (instead of forging), they say they've been able to produce metal that showed definite ductility at room temperature, and they believe that careful alloying and "certain combinations of straining and thermal treatments" can appreciably lower the ductile-brittle transition temperature. Further research, they hope, will markedly improve room-temperature performance.

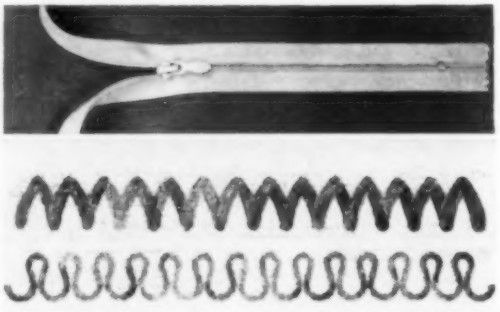
Portable combustion-tester for diesel engines . . .

. . . has been developed by Robert Bosch GmbH, Stuttgart 1, Germany. Primary elements of the tester are a suction pump, filter, lamp, photo-electric cell, and an indicating microammeter. It can be operated from a 6- or 12-v car battery.

Passing exhaust gas from the engine through the instrument causes black particles of unburned carbon to collect on the filter paper. Light from the lamp is reflected by the paper to the photocell, the amount of light received being measured by the microammeter. It is calibrated to be read directly in terms of blackening. By controlling the volume of exhaust gas drawn through the unit, the company says an accurate measure can be obtained.

Nylon zipper of new design . . .

. . . is being readied for market by Imperial Chemical Industries, Ltd. Instead of having individual molded teeth like an ordinary zipper, or interlocking grooves like the plastic zippers on pouches and portfolios, this one has interlocking surfaces made by intertwining extruded nylon filaments. On one side, a spiral filament is used; on the other, one of serpentine shape (see diagram). A special slide fastener locks them together. Result, says ICI, is a closure integral with the cloth to which it is attached, and one that is light, flexible, and nearly invisible. First applications are in the textile field, but it might well prove useful on instrument cases and for other industrial applications.



British zipper uses mating filaments, instead of molded teeth or convoluted strip. "Teeth" of serpentine filament interlock with spaces in spiral above them.

Cutaway section of Douglas Aircraft acoustic window used on the DC-7 below. The noise barrier is an acrylic pane (A) mounted in a foam rubber damper (B). Damper is retained in a metal pan (C). A flexible HYPALON seal (D) is compressed between the inner pane and the double thickness outer window (E). A neoprene seal (F) is cemented to the metal retainer.

Douglas Aircraft seals new acoustic window with Du Pont neoprene and HYPALON®

Douglas Aircraft has developed an improved acoustic window, designed for pressurized aircraft cabins. It is now in use on the DC-7, and a similar design will be used on the new jet DC-8. To meet the rigid demands of flight conditions, two Du Pont elastomers – neoprene and HYPALON – were selected to seal the window.

The flexible seal between the noise barrier and double pane (see D in diagram) required a resilient material with complete resistance to ozone and high color stability. In addition, the material had to show good low temperature flexibility without the addition of a plasticizer. (Plasticizers become volatile at the low pressures found at high altitudes, and condense on the window panes.)

Douglas engineers chose HYPALON because it was the only elastomer to meet these specifications. HYPALON has complete resistance to ozone. Unlike most rubbers, it can be compounded in a wide range of stable colors without sacrificing its other properties. This versatile synthetic rubber resists hardening at extreme temperatures (250° F.-350° F.) and retains its flexibility at temperatures as low as –40° F. without the use of a plasticizer.

Neoprene was chosen for the inner seal (F in diagram) because of its high resistance to ozone cracking. It retains its resilient properties in the face of heat, flexing, weather and sunlight. Neoprene is resistant to oil, chemicals, abrasion and cutting . . . and will not support combustion.

Investigate the design possibilities of Du Pont neoprene and HYPALON. Neoprene is currently used in aircraft fuel line connectors, heating system hose and cable jacketing. HYPALON is used in molded and extruded parts, fabric coating and convertible tops. For more information on the uses and properties of these versatile Du Pont synthetic rubbers, just clip the coupon below and mail today.

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What's happening in SCIENCE

Powdered-tin mystery

Powder-metallurgy techniques produce tin rods that are considerably stronger than cast metal—but the Tin Research Council isn't quite sure why. First guess was the added strength came from films of oxide around the powder particles. The guess didn't stand up to tests. Then, small additions of alumina, carborundum, and other refractory materials were tried—with no effect. Annealing after sintering did not seem to be the booster, either. TRI is preparing a report on the work, and planning to continue research.

Mines on the moon?

Could our long-term shortage of metals and minerals be solved by tapping the moon's resources? It's certainly a vast, untapped source—and one that should be easy to open since there is no covering layer of topsoil or habitation.

Not long ago, the suggestion would have been labeled "wild-eyed" or "science fiction." Now, it's being discussed in the halls of Congress as a perfectly sound idea.

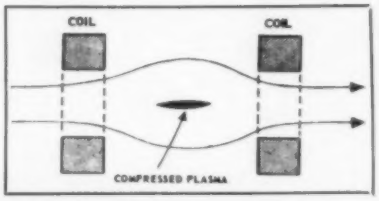
Sen. Clinton Anderson, of the Joint Committee on Atomic Energy, says an important byproduct of an outer space program would be that "man would learn about the resources on the moon and the planets, with a view towards their use after we have exploited the scarce resources of this world."

It's not likely that we'll be running regularly scheduled ore rockets within the next decade. But some day we may—another important reason why the race for the moon is so intense.

Trapping atoms to tap their power

New thermonuclear machines are bringing fusion energy (the "peaceful H-bomb") a step closer. One, just announced by the U of California Radiation Laboratory is called a "mirror machine."

Like the Columbus machine, Perhapsatron, and Stellarator (*PE*—Nov. 4, '57, p. 12), the mirror machine is designed to bottle up hot gases and encourage nuclear fusion. But it approaches the problem in a new way.



Mirror machine is designed to compress and hold hot gas in the center of a tube by magnetic forces concentrated at each end, as this AEC diagram shows.

As UC scientists explain it, the older machines are designed to establish an internal magnetic field in a hot gas (plasma), compressing and heating the gas, and creating a "pinch effect which forces the gas particles closer together to encourage a nuclear reaction."

The new machine, is a straight tube, surrounded by coils of wire to create an external magnetic field, stronger at the ends of the tube than in the center (see diagram). These constructions act like stoppers reflecting gas particles that would escape, and confining the gas in the center. (This "reflection" of particles gives the mirror machine its name.)

Research with the machine is still in its very early stages.

Advantages of the new design, say UC scientists, are increased stability of the gas and greater ease of control.

New words—I

Dictionaries go out of date pretty fast these days. The abundance of new developments—and new terms to describe them—makes it hard to keep up to date. Here, for ready reference, are brief definitions of some of the newer developments covered in PRODUCT ENGINEERING in recent months. Others will be listed in future issues.

Fission (atomic): The breaking down of a large, heavy atom, with the liberation of energy in the form of heat and gamma radiation, freeing of atomic particles, and creation of new elements from the larger fragments.

Fusion (atomic): The joining of two small atomic nuclei to form one larger one, generally with liberation of a good deal of energy. When this reaction involves extremely high temperatures (in the million-degree range), it is generally known as a **thermonuclear** reaction.

Plasma: Hot, partially ionized, electrically charged gas in which fusion reaction may occur.

briefs . . .

Infrared research progress reports are to be issued regularly by Bausch & Lomb Optical Co. The first, dealing with calcium aluminate glasses for transmission of infrared radiation, is now available from the B&L Defense Contract Dept., 635 Paul St., Rochester 2, N. Y. These glasses are themselves new, and still in the laboratory stage, but they offer interesting electrical and optical properties.

Operations are being frozen, quite literally, by Linde, U.S. Steel, and Bureau of Mines metallurgists. In an attempt to see exactly what happens inside a blast furnace, they're stopping action at midpoint by injecting a blast of liquid nitrogen, providing a sudden, complete, and drastic quench.

Gravity waves do exist. They are emitted by systems of moving masses and they carry energy, says W. B. Bonner of Queen Elizabeth College, London W8, Eng. In a communication to *Nature* magazine, he says it is possible to "show beyond reasonable doubt that gravitational radiation has, acording to the general theory of relativity, a real physical existence, and that it must be emitted in a wide class of particle motions."

Whether or not this mathematical demonstration stands up, the fact that a leading science magazine is willing to publish it is one more indication of the growing importance of gravity research (*PE*—Dec. 30, '57, p. 12; and Mar. 10, '58, p. 14). —ARG

What's happening in MATERIALS

Lower price tags for the higher-ups

"Down to $500 a lb" doesn't sound like much of a drop. But when the material is dysprosium, a rare earth that hasn't even been available in pound lots until now, it's a significant advance. And this is only one of the "rare" elements that is, at long last, opening up for engineering research and eventual commercial use.

Research Chemicals, P. O. Box 431, Burbank, Calif., which is offering dysprosium in commercial quantities, is also introducing high-purity terbium oxide and holmium oxide, and has cut the price of high-purity lutetium oxide from $150 to $15 a gm. Lindsay Chemical, West Chicago, Ill., has reduced samarium oxide from $1825 to $50; and other suppliers will probably follow suit.

These compounds are worth investigating because the rare-earth elements have many unique chemical, magnetic, electrical, and nuclear properties that recommend them for development of fuel additives, magnetic control and amplification devices, infrared equipment, and many other uses. (*PE—Jan. 13, p. 10; Jan. 27, pp. 7 and 14; Feb. 10, p. 14; and Mar. 24, p. 7*).

Plastics: new family a-coming?

A new plastic film—a vinyl fluoride polymer that may be the forerunner of a whole new family of strong, weather-resistant plastics—has been announced by Du Pont.

The film itself (tentatively labeled "Type R") is clear and colorless, transmits ultraviolet light, and, Du Pont says, has superior outdoor weathering characteristics, high mechanical strength, good heat resistance, and excellent chemical resistance.

Neither the film nor the new molding compounds are out of the laboratory stage, but film samples are available in limited quantities.

Materials for missiles

What makes a missile? Aluminum, magnesium, steel and ceramics, of course. But a lot of organic materials now rate the designer's attention—particularly as new facts are learned about their short-term heat resistance (see p. 5).

Among the organic plastics and rubbers now being designed into missiles, Aries Associates reports, are epoxies, polyamides, polyesters, phenolics, alkyds, silicones, urethanes, fluorocarbons, polysulfides and polybutadienes.

There are a good many new types of lubricants, too, including a number of metallo-organics—phosphorus-boron and tin-silicon compounds, for instance (*PE—Apr. 7, p. 5 and May 26 p. 20*)—and silicones, alkyl-silanes, fluoroalkyl silanes, and fluorine compounds.

Moreover, many of these have applications far beyond the missile field.

Heat resistance and electrical properties of phenolic plastics continue to bring them new jobs in "standard" products, as well as in special applications like missiles (see at left and p. 5). This centrifugal switch collar made of Bakelite phenolic is used in Bell & Gossett booster pump for hot water heating systems.

Making silver stay put

An unusual property of silver has been causing trouble in printed circuits and design of other electrical components. But a cure may be close at hand.

Troublemaker is silver's tendency to migrate under certain conditions. Under influence of a dc potential, it can travel right across an insulator, causing an electrical breakdown.

The problem has been serious enough to lead to rejection of silver coatings in some cases where they otherwise offer many design advantages over copper.

Now, though, researchers at Stanford Research Institute think they've found a way to keep silver in its place. In their report to a recent American Chemical Society meeting, on a study of migration causes and cures, they noted that addition of small amounts of copper to the silver seems to inhibit the migration. The reason, they believe, is that the copper forms an extremely thin but protective barrier around the silver.

This is not the only possible route to solution of the migration problem. Plated and organic coatings are also being tested.

briefs . . .

New chemicals from wood wastes are promised by Michael A. Brown of Rayonier, Inc. For instance, he says, a good deal of work is being done on the use of bark derivatives as replacements for synthetic phenolic resins. "Such materials," he notes, "are still in a relatively early stage of development." But he thinks much can be expected in this area.

Importance of adhesives is underlined by American Welding Society announcement that a section on this topic will be included, for the first time, in the next edition of its Welding Handbook, to be published a year and a half from now. Also new: a section on welding of plastics. —ARG

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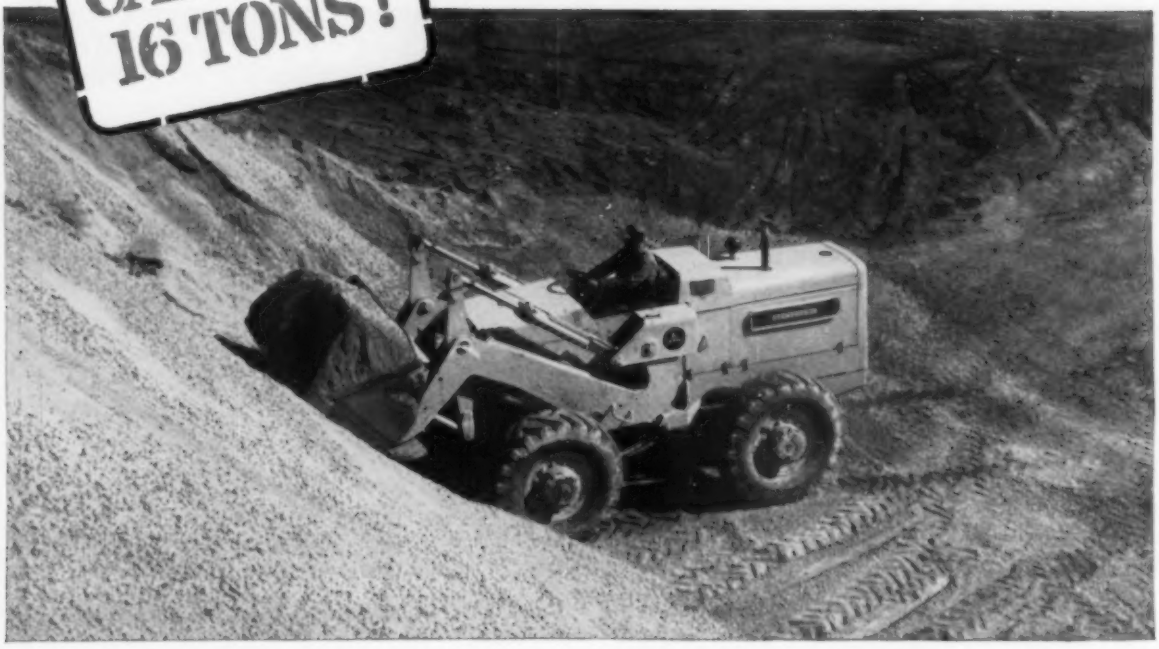

The continuing trend toward bigger capacities in heavy-duty materials handling equipment calls for more and more *planetary-drive axles*. That's exactly why The Frank G. Hough Co., makers of the front-end loader pictured above, went directly to the manufacturers of Timken-Detroit Axles.

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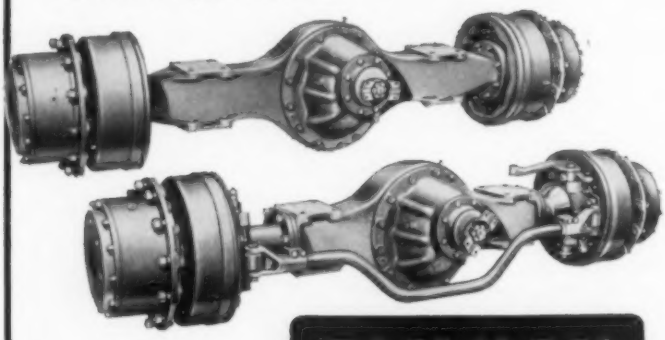
Timken-Detroit Rigid Planetary Axle



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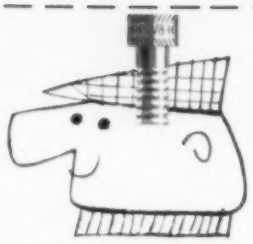
Here, the dominance of legal, marketing and financial men has been well established, reflecting the American emphasis on these phases. Not so in Europe. There the emphasis has always been on engineering. Engineering training is considered essential, in fact, for men in the other phases; the engineering degree (and usually an advanced one) is a badge of achievement far beyond its rating in America.

In the Soviet Union, for example, a chief engineer may command 2000 rubles a month—in contrast to 900 for a starting engineer and 1500 for an experienced one. But the engineer who has his degree as a "candidate of technical science" (roughly equivalent to our master's) is paid 2700, a man with a doctorate 4000. The coveted rank of Academician (member of the Academy of Sciences) draws a salary of 6000 rubles a month, plus other privileges. Compare this with the basic minimum wage of 375 rubles per month and you have some idea of the esteem in which academic achievement is held.

As our own products take the turn toward greater complexity, engineering training becomes increasingly important not only for their further development, but also for their marketing, servicing, production, and control. This predicts a further increase in the percentage of engineers in management.

It also suggests that we abandon the feeling that the engineer who specializes in one of the other functions has somehow denied or abandoned his profession. Design engineering will always be the heart of the profession, but having engineers in the other functions will make the designers' job easier. It will also make it easier for our companies to understand and cooperate with those of Europe, who have much to offer us if we know how to gather and utilize it.

But, most important, it will result in products that are of better design and manufacture, hence of greater utility and benefit to all our citizens.



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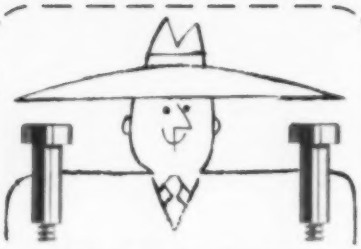

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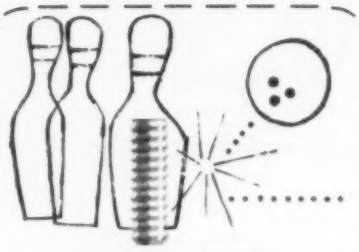
keep shoulders from sagging.

Used on either shoulder, or preferably both, P-K SHOULDER SCREWS will make you stand straighter, look better, may even result in getting you a substantial raise. Dependable, too. Heads are concentric with body for uniform, accurate assembly. Finished threads are close to shoulder for maximum holding power. And P-K SHOULDER SCREWS are accurate for positive internal wrenching and non-slip drive.



SET SCREWS

help make your score look good.

When the pin boy sets the pins for your opponent, he inserts a P-K SOCKET SET SCREW. Nobody'll know what's happening. Even a perfectly placed ball won't budge the pins as those P-K Set Screws hold them firmly to the floor. Same fine job in your plant, too. Use a P-K Cup Point for collars on pulleys and shafts, P-K Flat Point against hardened steel, and there's a selection of P-K Oval, Cone and Half-Dog Points from which to choose.

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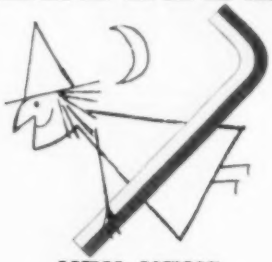

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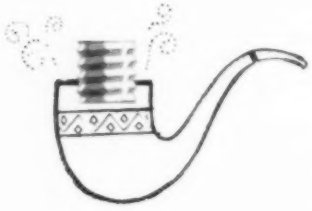

PIPE PLUGS

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Industry Borrows Polaris Planning

WASHINGTON—Something the general public doesn't realize about the Polaris missile is the success of the management program that is creating this new weapon system. The management setup is an aspect of Navy's missile idea that is attracting wide attention.

Navy's Polaris combines a solid-fueled, 1500-mile, atomic-warhead missile with nuclear-powered submarines capable of hurling the weapon from deep in the ocean. Original target date was 1962-1963; Polaris is now expected to be ready by 1960.

Navy attributes its success to a combination of technical breakthroughs, priorities, ample funds—and managerial success. The last-named factor explains why dozens of top company executives and government officials have been touring the Polaris management center in Washington. Many are adapting parts of the management system to fit their particular organizations. Among them are such companies as Hughes Aircraft, Lockheed, Aerojet and Sperry.

If any one person can be credited with success of the Polaris weapon system he's the director, Rear Adm. W. F. Raborn. Raborn's shop is nerve center of the whole Polaris program. Here, each week, those responsible for the program give an 8-minute summary of developments during the past week, (see cover photo).

PROGRAM PROGRESS RATING

The purpose is to keep the top-level military and civilian staff abreast of significant progress, problems, and events that have occurred in connection with Polaris. The reports carry an evaluation of progress toward meeting target dates set for completing the program.

Evaluation of progress is stated several ways:

In good shape, meaning all's well;

Minor weakness, indicating that generally the progress is going well but with some slight problems;

Major weakness, indicating a major problem that will require action by and Admiral; and the fourth term,

Critical, which means the matter is so urgent that the Admiral must seek aid from higher authorities.

To help relate all phases of the program to the over-all system, walls of the management center are covered with progress charts. There is a master chart showing progress of the over-all system, and one for each of the six major subsystems:

Launching and Handling
Fire Control
Navigation
Ship Operations and Test
Ship Installation
Missile

Take a Launching and Handling system, for example, (chart below); the staff breaks it into major components. Milestones are preselected, along with the dates when they are to be accomplished. Responsibility for the job is assigned, as well as support and monitoring roles. This information is charted with the name of the contractor or the government agency that is to actually do the job.

Symbols are placed alongside the

22 1-1-58

SAMPLE

an for . . . .

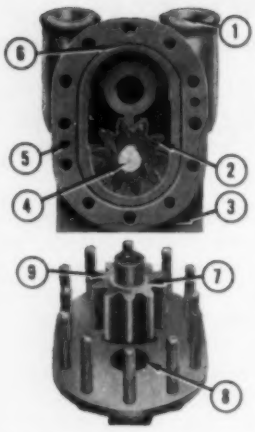
FBM Launching and Handling System

Develop tactical launching and handling systems for FBM Weapon Systems.

Y 1957 $ | FY 1958 $

MAJOR COMPONENTS	1957	1958	1959	1960	1961
	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N
221 LAUNCHING SYSTEM SUPPORTING PROGRAM	Design	Fabricate	Test	Evaluate	
222 LAUNCHING SYSTEM					

Responsibilities					Action Milestones		1957	1958	1959	1960	1961
	Direct	Supporting	Monitoring	Contractor			J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N
1	STG	20	22		●	Select Optimum System	Apr				
2	22	SpL			●	Begin experimental test and development of launching technique	Jul				
3	22	SpL	26 BuShips	WEC	●	Establish launching portion of System Envelope	Jul				
4	22	SpL	26 BuShips	WEC	●	Complete preliminary layout of System	Sep				
5	22		26 BuShips	WEC	★	Approve design of System	Dec (Nov)				
6	22	SpL	27 LMSD	NOTS/WEC	▼	Begin experimental test and development	Feb (Mar)				
7	22	SpL	26 BuShips	WEC	□	Determine system requirements on first design	Feb				
8	22	SpL	26 BuShips	WEC	★	Contract specifications complete	Jun				
9	22	SpL	26 BuShips	WEC		Begin manufacture	Jun				
10	22	SpL		WEC/NAEF		Complete delivery	Aug				
11	22	SpL	25/SpP	WEC/NAEF		Availability of DPL-1	Oct				
12	22/25			WEC		Test DPL-2	Jan-May				
13	22					First Polaris launching	Jul				
14	22	SpL	26 BuShips	WEC		Complete delivery of DPL-2A	Jul				
15	22	SpL	26 BuShips	WEC		Delivery of System	Apr-Oct				
16	22	SpL	WEC/LMSD	NOTS		Preliminary evaluation tests	Nov				
17	22	SpL	26 BuShips	WEC		Delivery complete System	Jan				
18	22	SpL	26 BuShips	WEC		Install System	Mar				
19											



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5. *Dowel pin alignment facilities accurate assembly with proper working clearances.*
6. *Grooves vented to pump suction eliminate gaskets and insure face and end plate sealing.*
7. *Bearings are assembled close to load to minimize shaft deflection. Provision is made for renewal of lubricant.*
8. *Shaft seals isolate main shaft bearings from abrasive liquids.*
9. *Hardened idler increases pump life.*
10. *Interchangeable return seal (not shown) vents stuffing box to pump suction to minimize chance of shaft leakage while also providing simple change of rotation in the field.*

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milestones as they are accomplished. One set of symbols is used if progress is on schedule; another, if it is ahead of schedule, or behind schedule. Thus, it is possible to determine exact status of the entire program or any phase of it at a glance.

The Monday-morning briefing sessions are in two parts. The first 1½ hours are devoted to progress reports. Recently, for example, Carleton Shugg, general manager of the Electric Boat Div. of General Dynamics Corp., spoke on the fleet ballistic missile submarine building progress.

Normally, 80 to 100 persons attend the briefing. Besides the regular staff, 10 to 12 contractors are normally represented, and a score or so of observers from the Pentagon or other government agencies.

At each briefing, the Program Evaluation Branch of the Special Projects Office prepares a brief resume of important decisions and observations that are made on the spot by Admiral Raborn. Here is a typical decision that was made at the April 14th meeting:

"A deadline date of 15 May is established within special projects for branch review of detailed shipbuilding specifications for the first boat, with a June 1st deadline for transmission to BuShips and Electric Boat." Once monthly, the Program Evaluation Branch runs a tally on these recommendations and reports to the Admiral if they have been carried out.

To feed information into the management center, the contractors submit weekly or bi-weekly reports. These give progress on the current milestones being worked on and a forecast for the next one coming up. Any delays anticipated, or completions ahead of schedule, are explained.

The combination of field reporting and Washington briefing is credited with keeping the Polaris program on a fast-moving, ahead-of-schedule pace.

SEEK IMPROVEMENT

Although Navy is happy with its present system, the management team running the Polaris-submarine program is continuously trying to improve it. For example, this February the Evaluation Branch of the Plans and Programs Div. of the Special Projects Office set out to devise a better program evaluation system.

Dubbed the Program Evaluation Research Task (PERT), the team is trying to come up with a quantitative formula that will measure progress and predictable future of each element of the program.

Although details have not been released yet, here is what Navy claims PERT will do:

The management problem is clearly identified with the network of events and their interrelationships outlined. This in turn shows danger signals and areas needing executive attention and action. Over-all, it permits systematic evaluation from top management down to contractor.

Problems and events needing decisions for time, resources, and specification (or performance) trade-offs are spotlighted. In effect PERT shows the critical time elements of effort to achieve a given goal—and shows the best current expectations for meeting objectives on time.

A key factor in the PERT program is that it faces up to, and makes systematic use of the fact that any scheduled research and development date involves a margin of error. PERT aims at finding the chance or probability of meeting these dates. This makes it possible to outline the impact of any time deviations on other parts of the total program.

Navy chose to be the weapons system contractor when it undertook Polaris. The total management team gathered together numbers just under 400 persons.

IN-HOUSE HELP SAVES TIME

Admiral Raborn says "the way to save time is to use existing laboratories and contractors." When he took over control of the program he was given authority to tap any government agency or facility that he needed. He has made wide use of existing Navy bureaus for such things as navigation, submarine design, etc.

Sounds Out Wire Flaws

BONN—By modifying conventional ultrasonic flaw detection techniques, the Bonn engineering firm, Siemens & Halske, can sound out physical discontinuities and defects in fine-gauge wire that goes into light bulbs and vacuum tubes.

In the ultrasonic test, the fine-

gauge wire is power drawn across two wave guides at a steady rate. Ultrasonic waves generated by a quartz crystal cause vibrations in one of the guides. The vibrations flow along the wire to the other guide that is linked with a detector screen. Flaws in the wire weaken the strength of the impulse reaching the second guide and reduce the pulse image on the detector screen.

If pulse amplitude varies more than allowed by pre-set tolerances, the drive motor shuts down and in some models of the test equipment an audible signal sounds.

Design High-speed USSR Phototelegraph

VIENNA—Russia's Odessa Electrotechnical Communications Institute has developed a new electronic phototelegraph which triples the speed of transmission.

It takes only two minutes to transmit a full page of text. With older methods, the light beam moves along the text of a telegram at a uniform and relatively slow speed, both on characters and on the blank spaces that account for up to 93% of the telegram space.

The new model is fitted with an electric device, slowing down the light beam as it moves along the text, and speeding it up 10-fold on blank spaces. The beam is produced by a television-type kinescope.

'Control Engineer' Comes of Age

LONDON—Control Engineering should now be recognized as a primary technology because it has developed its own philosophy and discipline, Sir Harold Hartley urged in his recent presidential address to the Society of Instrument Technology.

With control engineering being applied over an increasingly wide field, Sir Harold said, it should become an independent subject in engineering schools. The control engineer must be accepted as an equal member in an engineering project team, to insure that control is considered a basic element in the design stage of a project.

Russia, he said, has already realized the importance of automatic control.

MICRO-BEARING ABSTRACTS

by **A. N. DANIELS**, *President*
New Hampshire Ball Bearings, Inc.

MEASUREMENT OF RADIAL RUNOUT

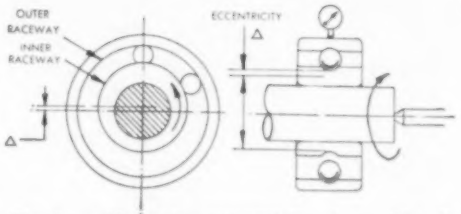

Fig. 1 — ***Measuring eccentricity of bore with respect to inner raceway.***

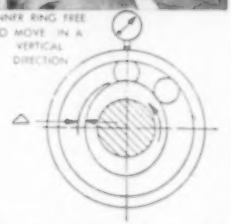

Fig. 2 — ***Inner raceway is out-of-round, although concentric with bore.***

Occasionally questions are raised about the methods of measuring "radial runout" and "out-of-round". In order to define "radial runout" properly, a discussion of "eccentricity" and "out-of-round" is necessary.

The amount of out-of-round, or lack of roundness of a given part (inner or outer ring or ball) is the difference between the maximum and the minimum diameter of the part in question.

Eccentricity refers to the distance between the centers of two circles. Concentricity refers to the exact coincidence of the centers of two or more circles. In high grade instrument bearings there is a very small tolerance on the permissible eccentricity between the bore and the inner ring raceway, and likewise between the outside diameter and the outer ring raceway.

Inner raceway out-of-round is measured by forcing the ring between the rounded edges of two discs, one of which is fixed and the other of which is mounted on the indicating mechanism. The difference between the maximum and minimum readings reveals the amount of out-of-round. Out-of-round of the outer ring raceway is measured by placing the ring over two rounded points which engage the raceway. One point is fixed and the other actuates an indicating mechanism. As the ring is rotated, the difference between the maximum and minimum readings indicates the degree of out-of-round.

The true amount of eccentricity between the bore and the inner ring raceway can be measured, providing these circles are not out-of-round, by mounting the assembled bearing on a slightly tapered arbor, applying a calibrated indicator on the center of the stationary outer ring, and then slowly rotating the arbor. The eccentricity is the difference between the minimum and maximum gage reading as the arbor is rotated through one revolution. Similarly, the eccentricity of the outer ring is measured by the difference in the dial readings with the arbor and inner ring held stationary while the outer ring is rotated one revolution. *Fig. 1* shows the set-up with an inner raceway which is eccentric with respect to the bore.

In the case above it has been stipulated that the bore and inner raceway must not be out-of-round, for only under these conditions is the true eccentricity measured.

If the raceway is out-of-round, while being either eccentric or concentric with respect to the bore, the out-of-round will be transmitted to the indicator, thereby influencing the reading. A condition in which the inner raceway is out-of-round although concentric is shown in *Fig. 2*.

In view of the fact that the majority of bearing rings will unavoidably be somewhat out-of-round and eccentric, however slightly, it is obvious that the measurement described above indicates neither true eccentricity nor true out-of-round but a summation of the two quantities. Hence, the measurement is more correctly termed radial runout.

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If you work with miniature bearings, you'll find this new, 70-page authoritative publication contains a further discussion of radial runout and is a great help in solving problems in designing instruments or small electro-mechanical assemblies.

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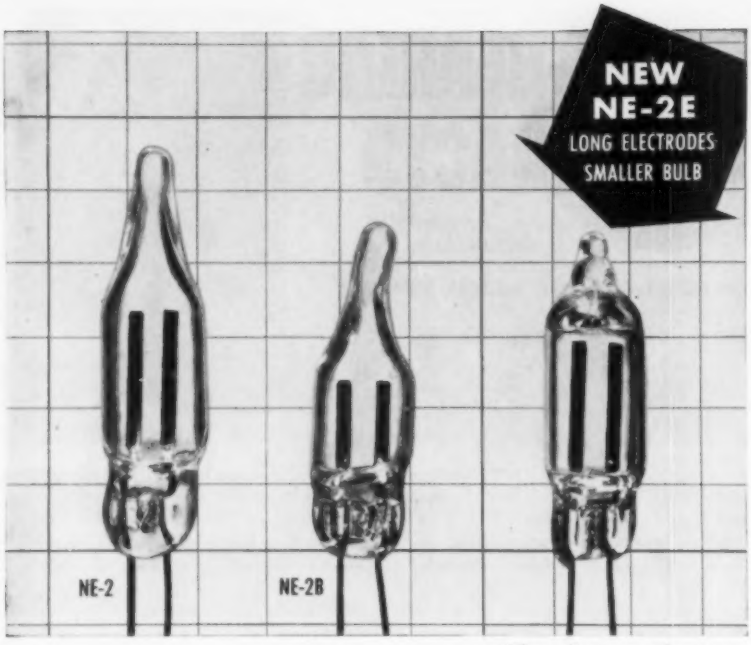

Three diameter enlargement

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Californians Pioneer in Switch to Desalted Water

COALINGA, CALIF.—The first water desalting plant to serve a US city will be installed in this city of 6,000 people in the San Joaquin Valley.

A 28,000 gallon-per-day electric membrane plant, built by Ionics, Inc., Cambridge, Mass., will be installed late this year to furnish the city's separately distributed drinking and cooking water (*PE*—Oct. 7, '57, p. 23).

The city has always had plenty of well water, but it is too salty to drink. So, since 1900 it has been necessary to haul in fresh soft water 45 miles by rail. Last year the city's water freight bill was over $43,000 for a daily supply of about 17,000 gal.

The new Ionics plant will expand the drinking water supply 50% by electrically removing excess minerals from the city's brackish well water which contains about 1/15th as much salt as sea water. The plant is expected to save the city over $400,000 in the next 10 years.

The Ionics process is suited to freshening waters with a salt content 1/30 to ½ that of sea water, but which are still undrinkable. Passing electrical current through the water removes salt ions—plastic membranes pass salt but retain the water. The desalted water is pumped to a water tower for distribution and the salts removed are flushed away as a weak brine.

British Claim Flight Without Flying

LONDON—The *DAILY TELEGRAPH* announces that British scientists have discovered a revolutionary method of moving weights of many hundreds of tons through the air at speeds up to 200 mph.

The technique has no connection with flying in the accepted sense, according to the newspaper, and does not involve the use of aerodynamic surfaces. The method is said to be so simple in principle that those concerned are surprised it has not been discovered earlier.

The announcement says the National Research Development Council has awarded a contract to an aircraft firm for further investigation of

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the idea, and it is planned to build a small prototype machine capable of carrying one man—a machine that will not be lifted or propelled by engines such as downward pointing jets, though a low-power diesel engine "may be used indirectly." Official sources declined to comment on the *TELEGRAPH* story.

Seek to Boost Supply of European Engineers

PARIS—The Organization for European Economic Corporation (OEEC) has set up a special agency to direct its drive for increasing the supply of qualified engineers and scientists in Europe.

The agency will be called the Office of Scientific and Technical Manpower. Dr. Alexander King will head the new group as director, though he will continue in his post as Deputy Director of the OEEC's European productivity agency.

The new group will be financed by contributions of OEEC members and associate members. The US has allocated $500,000 to the agency.

Actually, OEEC already has been active in the field of scientific manpower problems. The new agency will step up such activity.

Small Rocket Engine to Test Ceramics, Parts

COLUMBUS, OHIO—Battelle Memorial Institute scientists under contract with the Wright Air Development Center, at Dayton, Ohio, are working on a miniature rocket engine.

The experimental engine, if successful, will be used to test ceramics and parts made from hard-to-get special carbides and refractory borides.

Battelle says it has developed a miniature meter with a ½-in.-wide combustion chamber, powered by an oxygen-hydrogen mixture that allows for a thrust of 5 to 7 lb.

Researchers said the first project would be evaluation of rocket nozzles made from new ceramic materials, provided the miniature motor proves an accurate counterpart of the full-size one for testing purposes.

Such research "in miniature" will be much more economical, due to costliness and scarcity of the materials being tested, it was explained.

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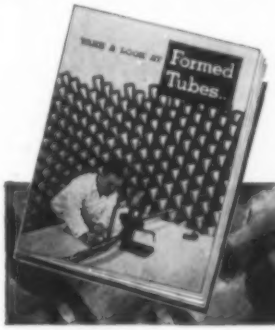

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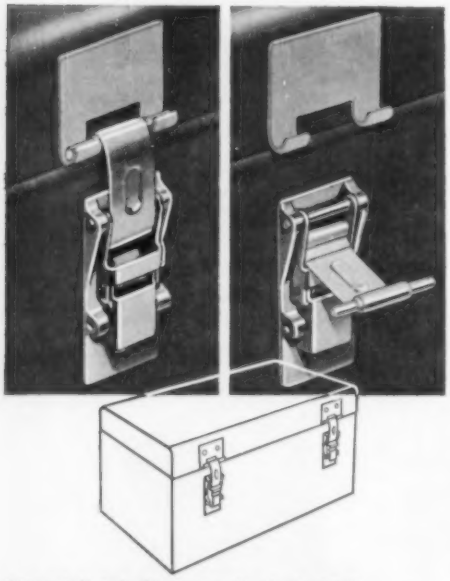

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Automated Steel Scrap Process Still a Secret

HOUSTON—A new method of processing steel scrap, such as from automobiles, which eliminates most of the rubbish previously captured in the bundled scrap process, has been developed by Proler Steel Corp., here.

San Proler, president, says the percentage of steel yield from the product produced by the new process is in the high 90s. This is in comparison to between 75% and 80% of steel in bundled scrap.

Chief advantages over the bundled scrap are the elimination of nonferrous materials and other foreign matter from scrap steel, and less melting time.

Patents are pending on the process, a closely guarded secret. Equipment is pushbutton-operated but no other details have been given.

Capacity of the Houston plant is expected to be between 500 and 1,000 tons of processed scrap per day. Armco Steel Corporation's Division at Houston has contracted for the entire output.

Proler wouldn't talk about comparative costs or prices but mentioned that plans are under way for other plants.

Steelmakers say the new process could increase the amount of raw materials available to the steel industry by making available for scrap such consumer items, as appliances, which have been unusable because of the amount of rubbish.

Electrolytics Machines Cemented Carbides

BONN—Soviet metalworking engineers say they have used electrolytic action to obtain higher efficiency in machining cemented carbides. The rate of stock removal, they say, is twice that achieved with conventional diamond wheels. And micro-hardness on the surface of the carbide tool is comparable to that obtained when diamond dust is the abrasive agent.

The abrasive wheel is rendered conductive to electricity by metal deposition, impregnation in a molten metal, or by using graphite as a bonding agent. Clearance between workpiece surface and conductive binder caused by projecting grains of the abrasive are filled with fluid by sub-

merging the wheel and workpiece partially in electrolyte.

Current flowing through the wheel dissolves the metallic binder in the cemented-carbide workpiece, the anode, at the same time that the anodic protective film is ground away by the abrasive grains of the wheel. Grain wear reduces clearance between tool and workpiece, and causes an electrical discharge that in turn burns away the graphite and assists grain breakaway from the parent wheel. The low pressure applied by the grinding wheel helps to attain high dimensional accuracy of the workpiece.

Engineers May Need 'Get-togetherness'

Los Angeles—By "letting the facts speak for themselves," the engineer isn't getting through to the people who make the decisions.

He may be a genius in developing a superior ICBM, but in presenting his case before legislators or city councilmen, he is often "uncomfortable and inept," says Ellis F. King, associate professor of engineering at the Univ. of California here.

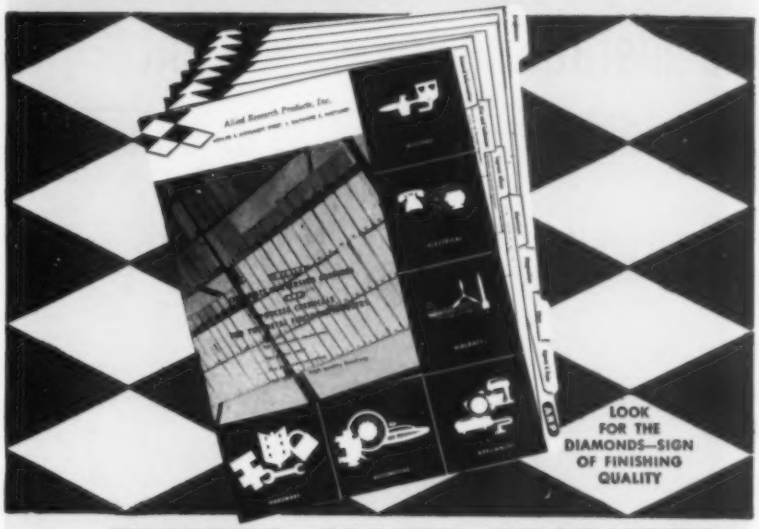
He believes the engineer's ineptness stems from scientific training which tells him that if the right facts are presented the correct action will automatically follow, and from his ignorance of the human emotional factors which in the end move committee chairmen, town planners, and newspaper readers.

Though his achievements may determine the survival of every citizen, the engineer, according to King, also lacks the personal contact with his "clients" that humanize the other professions. A patient follows his doctor's treatment, a juror hears the lawyer's plea, but the engineer's work is often too remote and incomprehensible to mean much to the nonprofessional.

To get his ideas across and make them effective, the engineer must assume a larger responsibility in the everyday affairs of the nation, King believes, and improve his skill in human relations.

On the other side, the people holding political and administrative power in city, state, and national governments, must learn to accept the engineer's bald facts without the sugarcoating of emotional salesmanship.

Useful Technical Data File...



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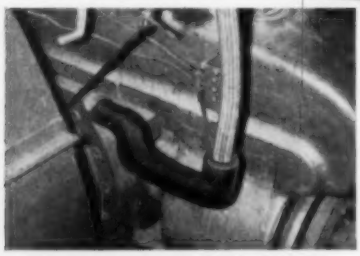

Flexible tubing can be easily installed onto piping with swings and bends up to 180°.

Slit tubing with adhesive applied fits snugly onto joint.

Complete data, applications and specifications on RUBATEX Closed Cellular Tubing Insulation—specially developed tubing for OEM, commercial, industrial and residential heating and cooling lines, chilled water and other cold lines where service conditions are moderate.

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PIONEER MANUFACTURERS OF CLOSED CELLULAR RUBBER

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Attach to your letterhead and mail this coupon for your copy of new Rubatex Tubing Bulletin today!

Soviets To Wind Up Their Industry

VIENNA, AUSTRIA—The scientists of Kazakhstan have succeeded in utilizing the accumulated force of the winds.

The specialists have used the idea advanced by the well-known Russian scientist Alekzander Ufimtsev, who 40 years ago, proposed to store wind energy in the form of hydrogen produced by electrolysis of water.

In the Steppes Region of Kazakhstan, seven hours travel distance from Alma Ata, a wind-electrical power station has been set up for the storage of wind energy. It consists of a wind motor of 25 kw, an electrolizer, and an internal combustion engine suitable for work on hydrogen gas. With the use of electrolysis, hydrogen is obtained without the need of compressors.

The speed of the wind here is often from 18 to 20 meters per second which enables the windmill to produce electric energy and at the same time, by means of electrolysis, to produce from 18,000 to 20,000 cu meters of hydrogen. This amount of hydrogen, collected in gas holders, is sufficient for the production of from 18,000 to 20,000 kw hrs of electric power during periods when there is no wind.

The coefficient of efficiency of the hydrogen motor is from 30 to 25%. In the opinion of the scientists this may be raised to 50 to 60%.

The use of the method of storing wind energy by means of the accumulation of hydrogen will help solve the problems of obtaining electric power in the deserts and the Steppe where there is no fuel for thermal power stations or large rivers which could make hydropower stations.

Seek Hi-temperature Aircraft Windshields

CORNING, N. Y.—A contract for development of high-temperature windshields to withstand 850-900 F temperatures in continuous use by supersonic aircraft has been given to Corning Glass Works by the Air Materiel Command, US Air Force.

Other objectives in the three-year development contract are: better optical properties and a higher strength-

to-weight ratio than achieved in present standard aircraft windshields.

Both flat and curved windshield sections will be developed. Because of the high-temperature requirements, the program will involve new techniques for shaping, laminating and mounting the windshields.

Special high-temperature glasses and laminates will be adapted. The glass will be ground and polished and processed for high strength and the windshields coated with an electrically conducting film to act as a de-icing and de-fogging agent, and to reflect solar infrared radiation.

KEEP CONVENTIONAL COCKPIT

A successful high-temperature windshield will permit traditional cockpit design to be retained. Corning says this program will assist future development of glass capable of efficiently withstanding temperatures up to 1800 F.

The operating temperature range called for in the new contract is about double the limit of glasses used in present standard windshields.

Aluminum V-8 automotive engine . . .

is lowered into a test car at General Motors. One of three experimental models, engine has a compression ratio higher than conventional engines (now averaging 9½:1) and weighs 30% less—its chief advantage—than standard engines of equal displacement and hp. The metal is also easier to work than cast iron. Major production hurdle to designing aluminum engines, GM says, was finding a reasonably priced material for cylinder bores. The engine has been six years in development. Extensive tests will follow.

New applications

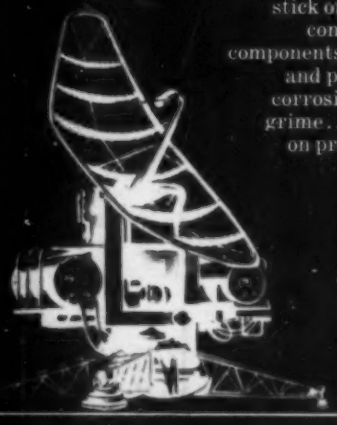
High performance vanes for miniature aircraft pumps and jet engine fuel pumps

Radar contacts and other electronic parts withstand continuous rugged service

–for self-lubricating

MORGANITE

Morganite components provide complete reliability in many types of airborne equipment. Morganite will not warp, stick or gum, is self-lubricating, non-contaminating. These dependable components function in high temperature and pressures and are unaffected by corrosive chemicals, oil, water, gases, grime . . . the standard of performance on process equipment, compressors, meters, pipe line and general industrial machinery.



For trouble-free operation — Install Morganite bearings, seal noses, pistons, piston rings, rod packings, gland rings, slides, valves and special parts. Call or write today for recommendations on specific applications.

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Manufacturers of Fine Carbon Graphite Products including Mechanical Carbons, Motor and Generator Brushes, Carbon Piles, Current Collectors and Electrical Contacts.
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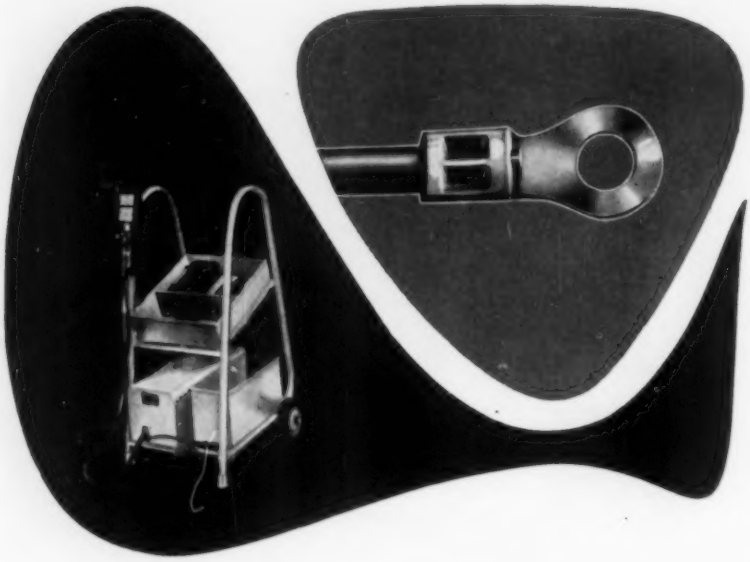
and DYNA-CRIMP® tools—



the right combination . . .

for electrical power generation and distribution

Take any assortment of conductors—solid, stranded or irregularly shaped. Add one A-MP Solistrand terminal. Bring them together in the proper A-MP Dyna-Crimp tool.

The result is always the same—an electrically-perfect, crimp-sure attachment at lower installed cost. Top performance even in adverse conditions.

And Solistrand needs no servicing. This is especially valuable where you have power machinery that must be left unmanned for long periods. Check these important Solistrand features:

- Exclusive double-indented crimp weds Solistrand barrel to conductors in a never-fail attachment.
- Crimping action of Dyna-Crimp tools forces combinations of conductors into one homogeneous mass. It does this at exactly the right pressure—no more, no less—for maximum conductivity and maximum strength with no weakening of conductors.
- Solistrand terminals are scientifically engineered in sizes to fit wires from No. 22 to 600 mcm.

And to serve you better, AMP maintains an international staff of field engineers capable of solving all your terminal problems.

Write for our Solistrand terminal and connector catalog.

AMP INCORPORATED

General Offices: Harrisburg, Pennsylvania

A-MP products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

Faster Corrosion Test Cuts Designing Cost of Heat Exchangers

READING, PENNA.—A more precise method of measuring corrosion rates of steels subject to high-temperature aqueous chemical solutions shows promise for more economical design of heat exchangers.

Developed by Carpenter Steel Co. and shown at the opening of new corrosion-study facilities, the test simulates heat-exchanger operation in the range 60 to 200 C. It is especially effective for reproducing conditions in equipment using steam or electricity as the heating medium.

SPECIMEN HEATED EXTERNALLY

In contrast with standard boiling technique, the specimen is heated externally to a different temperature from that of the corroding medium. This gives a corrosion rate that can be many times that determined by boiling tests.

For example, stainless heat-exchanger tubing (Carpenter No. 20Cb) in boiling 20% sulfuric acid has a measured corrosion rate of about 55 mils per year by standard boiling tests at 105C. But when the metal temperature is increased to 120 C, corrosion rate jumps five times, to 260 mpy. This effect can be modulated by lowering metal temperature through additional surface area, or by selecting alloy with a lower corrosion rate. Either step may mean increased exchanger cost, but equipment life is prolonged—and predictably so.

NO EDGING

Edge effect—faster corrosion during test resulting from specimen edge exposure—is eliminated, an important factor since edges are rarely exposed in actual service. To do this, a disk specimen is clamped between flanges: Top flanges hold a glass vessel containing the corrosion solution and a reflux condenser to maintain concentration; the bottom flange holds the specimen heat source—an ordinary soldering iron.

Carpenter reports that corrosion rates measured by the new test check closely with service life data in heat exchangers operated under the same conditions.

Bits and Pieces

General Electric has announced a **xenon arc lamp** expected to have wide application in printing-industry equipment. Operable as soon as current is turned on, the 300- to 3000-w lamps produce energy across the visible spectrum. Equipment to apply the lamp in graphic arts trades has been designed by American Speedlight Corp. Other new designs that may stem from the lamp are more convenient machines for making blueprints or black-and-white prints from engineering drawings, and equipment to print textile patterns on rollers. . . . **A spot survey by the Society of the Plastics Industry** shows that sales of plastics to mold manufacturers and proprietary molders are running equal to last year, or are up 10% to 20%.

West Berlin newspaper *Der Kurier* says it is likely Russia's third Sputnik was to be fired before May 1 but either was postponed or failed. The paper carried a photograph of the cover for the May 1 issue of an East Berlin publication, which greeted "launching of Sputnik III into the universe." The cover was seized by the governmental press service—an event that *Der Kurier* interprets as confirmation. . . . **Red China has turned out its first passenger car**—a 6-seat sedan. Announcement from the No. 1 motor vehicle plant in Changchun says the 70-hp vehicle is working well but "improvements will be made in the design prior to full-scale production."

New president of Canada's Engineering Institute holds the view that barring Canada's labs to visitors locks out more than it locks in. Hence, he says, Canadian and Russian engineers will exchange visits this year. . . . Market for aluminum foil packaging doubled in volume between 1952 and 1956 and is still growing according to Paul Murphy, vice-president of Reynolds Aluminum Sales Co. Big problem is to develop machinery for filling, closing aluminum foil containers. . . . **A fishing craft propelled by twin "hydrojets,** developed by Hanley Hydrojet, Inc., has gone into service at a cannery in Cordova, Alaska. The hydrojets are powered by two 160-hp turbocharged diesels.

WHAT CAN YOU DO WITH THIS FLEXIBLE, DURABLE METAL-MESH FABRIC?

Metal-mesh fabric—flexible, durable and with open mesh—has been accepted for years as a basic material for the fabrication of woven wire conveyor belts. Recently, though, resourceful design and production men have been finding new uses for this versatile woven wire construction. For example, slings for materials handling, protective curtains for forging operations, containing curtains for heat treating operations, tread reinforcements for modern high speed tanks, and even such domestic articles as doormats, fireplace screens and flexible room dividers.

Here are the important physical characteristics of metal-mesh fabric. How can you use them in your designing or production operations?

FLEXIBILITY—spiraled wire construction gives complete one-direction flexibility. You can coil it, draw it up on itself as a curtain or take it around corners.

OPEN MESH—Mesh size can be varied from 1/64" to 2½" or larger to provide for the passage of air, liquids, light or gases, but retain solid matter or particles.

DURABILITY—this fabric is of all-metal construction and can be produced in any metal or alloy, thus can be made resistant to heat, cold, corrosion, erosion or damage from impact or shock.

VARIETY—metal-mesh fabric can be woven to any length or width and in any of nine basic patterns. Further, any number of special side, surface or end attachments can be fitted to it.

WANT A SAMPLE?

Simply tell us what you have in mind as a possible use for metal-mesh fabric and we'll make up a sample section for your inspection and testing. Our own Field Engineer in your territory will deliver your sample to you personally and discuss your application with you.

Write direct or look under "Wire Cloth" in your classified telephone directory to talk to the Cambridge man nearest you.

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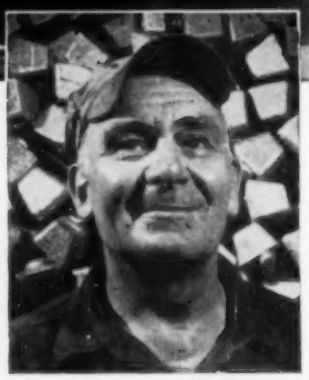
accurate!

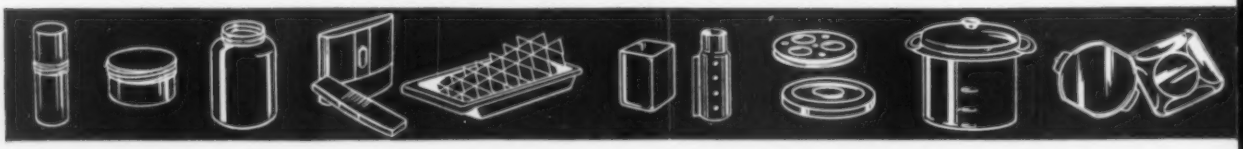
...in gauge *and* temper!

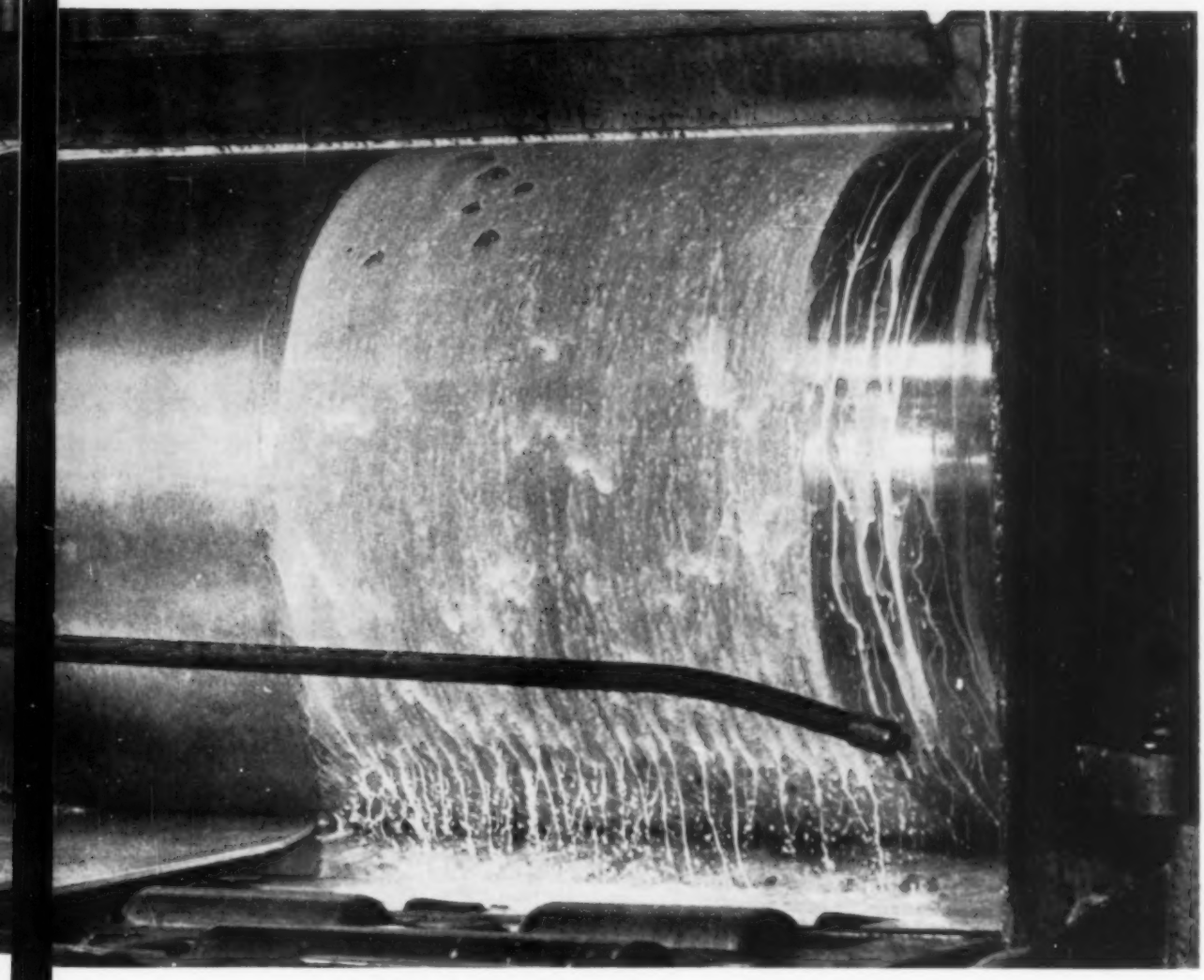


John Brochm, big boss of the breakdown rolls, has been putting pressure on aluminum for 31 years. "No matter how thick or thin you squeeze it, it's always 'the finest aluminum,'" is the way John puts it.

The pressure's

Much of the sheet aluminum used in our five large fabricating plants is produced in our *own* rolling mill. This on-the-spot control permits us to give our customers finished components made from metal of standard or special tempers and thicknesses. Aluminum sheet for parts of all sizes, from the smallest, light-gauge tube shields for portable radios to heavy-gauge deepwell cookers and 4-foot ceiling panels, is accurately controlled throughout the breakdown roll and rolling mill processes. This control of accuracy assures a minimum





on...375 tons of it!

rejection rate of the end product into which the metal is formed. Our rolling mill operation, with its entire output for exclusive use in our stamping plants, has the further advantage of speeding up production schedules, since it eliminates delays due to shipment of metal from outside sources.

If accurate operation and skilled production planning appeal to you, send us your inquiries . . . or even better, visit our plants to see how our facilities can help *you*.

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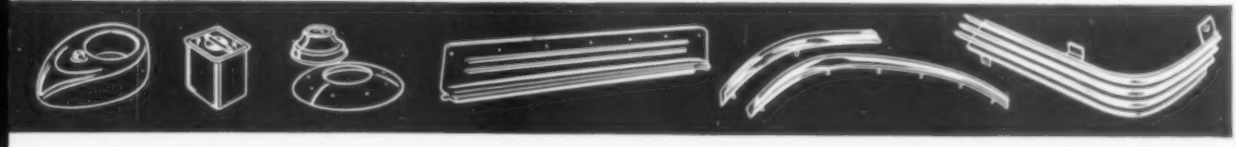


Personnel men . . . engineering administrators . . . if you want a man brimful with new ideas remember this: Creativity doesn't necessarily come in a gray flannel suit. The author here makes a plea for more tolerance. He says it will pay off!

Mr. Lichtgarn lists over 100 inventions, original ideas, and theories to his credit. He has made special studies in over 50 fields, including watch design, meteorology, and electron microscopy.

He has been project engineer, US Army inspector, procurement engineer for a large government research laboratory, and has done consulting work in manufacturing problems and in the origination of new products.

His special interest in creativity and the problems of gifted people in a world like ours led him to write this article—third in our series on the American inventor.

can you spot a CREATIVE

most employers can't—because they don't know what to look for

FRED LICHTGARN, *Engineer-Inventor*

■ When will employers learn that they can't spot creative men by checking resumes? That education, appearance and fine employment records aren't signs of creativity?

The creative man is different—and because he doesn't fit into some Personnel stereotype, he's treated like a leper in the employment office. He rarely gets upstairs. But suppose he does—suppose he walks into **your** office. How can you tell if he's truly creative?

Certainly not by his appearance. Ignore his unpressed suit, his loosened tie, his frayed collar. Don't mind if his nails hint he's never seen a manicurist—his mind is on more important things.

You have to talk to him, draw him out, find out what he's done—and see if he can prove it. If he has patents, newspaper clippings, letters, documents of any sort, fine. If not, get your information by pointed questioning.

How he talks is very important. See if he's just trying to impress you. Beware the braggart—most likely not a creative person. Beware, too, if he clams up when you're pinning him down to technical points.

Or, does he turn out simple, direct, honest, sincere, unassuming? Does he show great interest, become alive, only when he talks about research or about a problem? Then don't mind if he goes deadpan, gropes for words, and becomes embarrassed at small talk—that's good.

Were any of his inventions made at the drop of a hat—or with only an hour or two of thinking? Can he elaborate on a few? Ask if any of his inventions were arrived at intuitively; if he swings immediately into an easy, spontaneous explanation of some spur-of-the-moment inventions, better watch him—he may be good.

Find his interests. Does he like music? Do colors thrill him? Does he paint, or play some instrument? Does he prefer quiet to noisy pastimes? The creative man is usually artistic, likes quiet, and can work with pigments.

HOW TO QUIZ HIM

You've made a quickie appraisal. Now it's time to dig deeper. Ask specifically what he's designed and invented—and look for signs of creative thinking. See if his inventions were thought out **first**, then if they worked as planned.

Was he interested in inventing, in tinkering, even as a child? Can he show, on the record, new ideas of 10 to 15 years ago, ideas then unmarketable, but which today are successful products?

In conversation, can he easily give a few examples where he took odd, totally unrelated facts and came up with a totally new use, product, process, or idea? See how he invents: Mental building and rebuilding, acute observation, or intuitive flashes of understanding are good signs.

Does his record show an idea that's completely new and original? So new that it opened up other new fields of research—with seemingly no end to its possibilities? Good! And if this invention was in a field where much prior art existed, excellent!

ENGINEER?

Now see if he's ever solved a problem outside his field, found an original answer, when experts had failed. Does he have some ultra-difficult long-range projects he has played with for years? It might be solar energy, gravity insulators, or whatever.

A creative man usually gives experts credit for conventional thinking, and goes from there: He looks for the abnormal, the non-obvious, the impossible answer—and makes it work.

HE'LL HAVE ANSWERS

Ask him if he ever lacked some gage, instrument, or meter that he needed—and what he improvised to do the job. Maybe he put it together from his junk box. Does he store odds and ends because someday he may use them? Excellent!

Has he several patents? How many? And how many more would he have if he had the money to pay for them? Ask how many patents he's examined closely—the more the better. See if he's got patent sense: Can he tell if an idea is probably patentable? Does he know patent law? Good. If he's ever written complete patents himself, **very** good.

Patents speak for themselves—they're proof of creativity. Look his over. Do any clearly show an imagination tempered with practicality, beautifully adapted to fill a definite need? Some should be out of the ordinary, the routine, the expected—sort of breathtaking, pitched to a higher tempo, distinctly stimulating, thought-provoking—the result of **different** thinking. Some of his inventions should almost jump from the paper and hit you. And if any are utterly **simple,** sign him immediately—he has it in him!

THAT JOB TROUBLE

Don't be too concerned with his past work record—it's usually bad. In fact, the employment record of many creative and gifted people is a mixed-up mess that makes the efficient personnel director see pink elephants. His first impulse—one that he usually carries out, fast—is: "Get this man out of here!"

For the more creatively gifted a man is, the more difficulty he has making a living at his best level. Instead of welcoming him, employers shove him out into the cold. And good riddance, most of them say, at best he'll disrupt a well-oiled organization, for the creative man is not the Organization Man.

He prefers to work alone. But he seems raring to go, and given opportunity and encouragement, he'll overflow with ideas. He drives himself. It should be clear that he needs little or no supervision. He may have worked as an elevator operator, taxi driver, even as a factory hand, just to eat—but he still keeps his true vocation—creating—in evenings, mornings, afternoons, whenever he has spare time.

Naturally, his wandering from job to job looks poor on an employment record. The truly creative person is versatile. He can do well—often exceptionally well—in many fields. But he must be challenged . . . he must feel he's doing his true life work . . . or he'll become disgusted, frustrated, resigned. He changes jobs often because he's forced to work below his creative level.

You must remember to appraise him by accomplishments, not credentials. Though his shoes aren't shined and his hair is tousled, though he's had 10 jobs in 10 years, **check what he's done.**

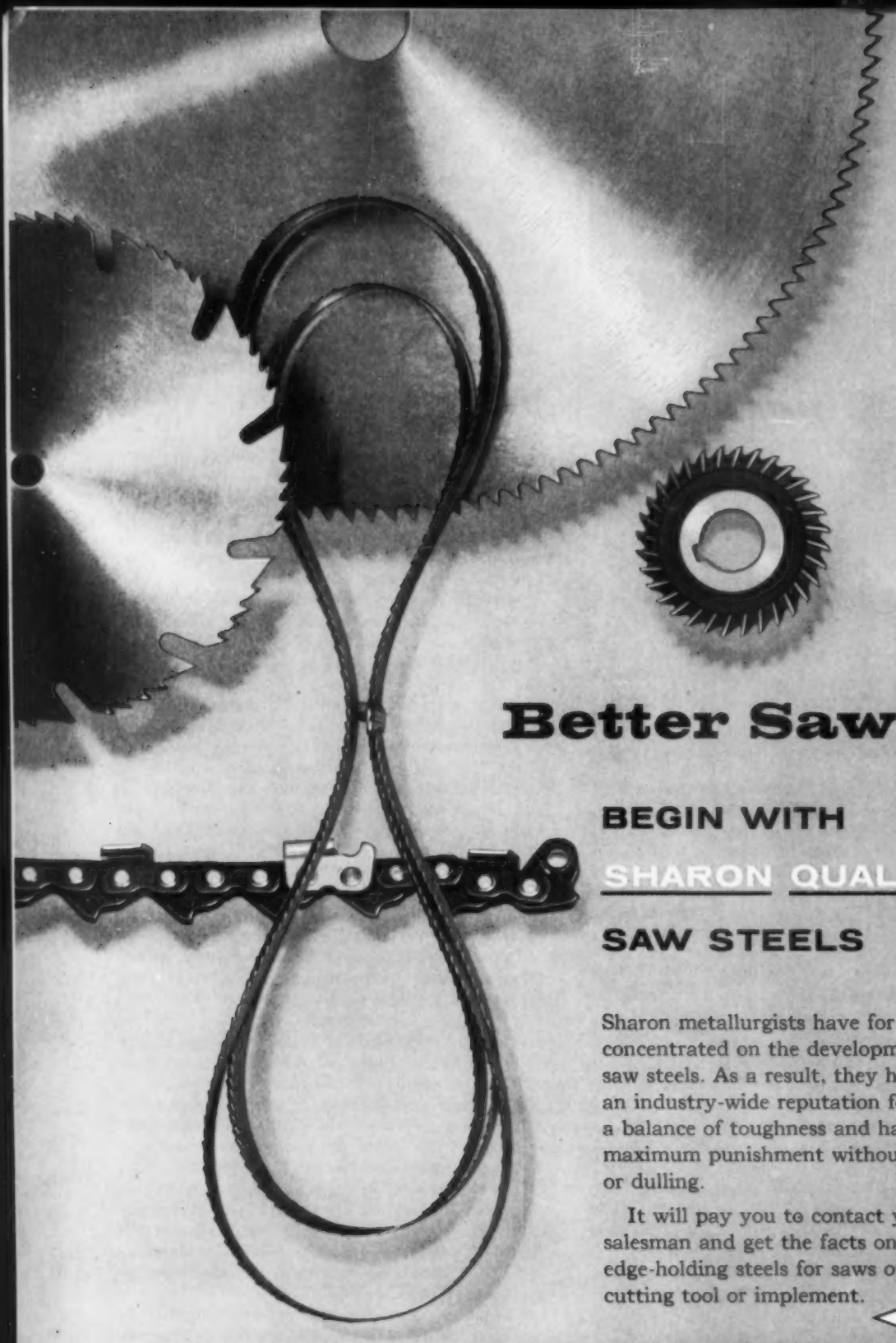
Does his record show continual growth, year after year—new ideas, concepts, inventions? Does each year show ideas of greater magnitude? Does he have, let's say, at least two new ideas per year? And are his inventions at least semi-basic in character? For the truly creative man is no mere *improver* of existing products.

Can you detect a slight bitterness?—most creative people are sensitive, take a terrible beating early in life, and learn to pay little attention to others. If you want creativity you'll need to be understanding.

Remember that formal education is no sign of creativity—not by a long shot! All the colleges in the world will not put one drop of originality into a person. In many cases, formal education is a detriment to the truly creative person and a waste of his time. The knowledge and facts he needs seem to come to him naturally.

All people have a certain amount of creativity, especially as children. The creative man retains and increases his creativity; the great mass of people soon lose theirs. It's just like forgetting a formal education: A normal person can forget all his physics or chemistry in 25 years, but in the same time, a creative man can double his creative capacity.

It is not enough to advertise—as many companies do—for creative men. You have to know how to recognize them. And by their works you shall know them—not by their appearance or education or their superficially fine employment records. ■



Better Saws . . .

BEGIN WITH SHARON QUALITY SAW STEELS

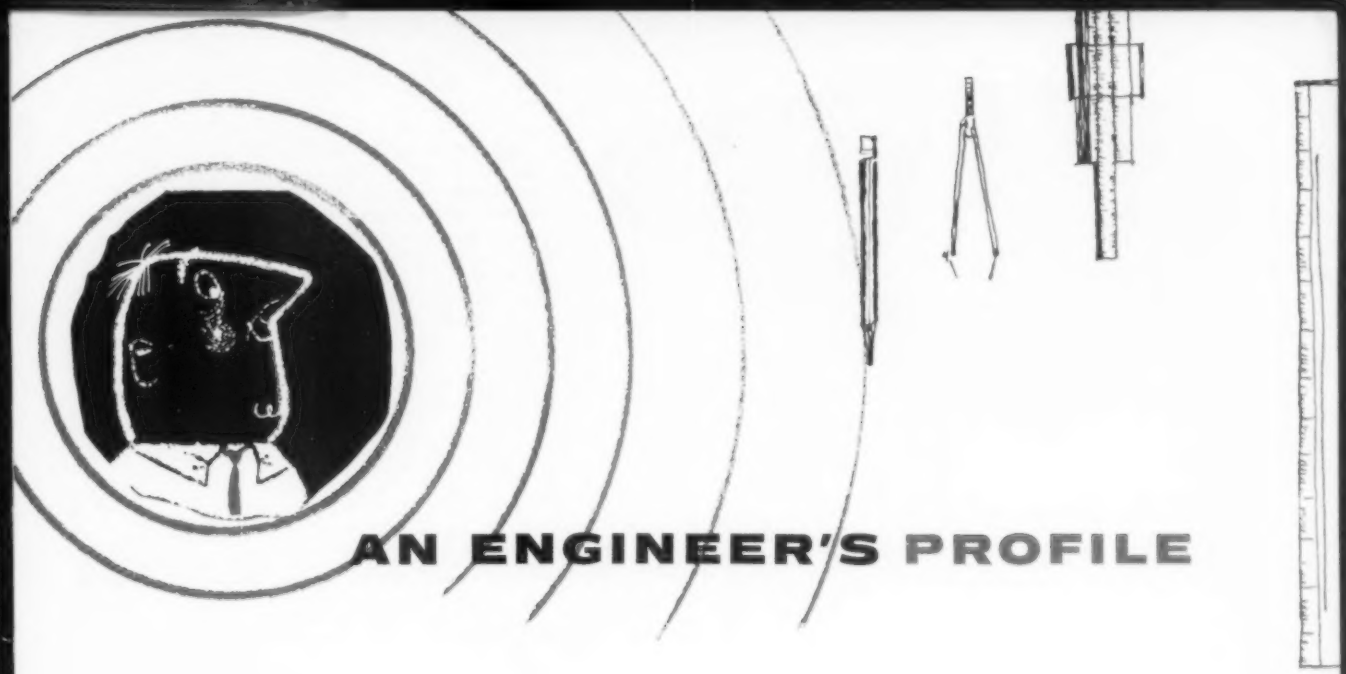
Sharon metallurgists have for the past decade concentrated on the development of better saw steels. As a result, they have established an industry-wide reputation for steels with a balance of toughness and hardness to absorb maximum punishment without fracturing or dulling.

It will pay you to contact your Sharon salesman and get the facts on these durable, edge-holding steels for saws or any cutting tool or implement.

SHARONSTEEL

SHARON STEEL CORP.

SHARON, PENNSYLVANIA



AN ENGINEER'S PROFILE

Now engineers are being motivation-researched too. Gaynor & Ducas, Inc., an advertising agency, has come up with the following personality profile. Do you recognize yourself here?

■ Engineers as a group are well above average in intelligence.

They tend to be more thing-minded than people-minded. They are not usually at their best in situations which call for a large vocabulary in oral or written expression.

They are methodical and logical in their approach to their problems. They like to use "formulas" and slide rules wherever possible, and to feel that what they are doing is practical and effectual.

They dislike quick deadline immediacy—prefer to take time to analyze and think through the implications of the problem.

They are fundamentally "down to earth" and dislike exaggeration.

They are quite independent, and better able to direct themselves in their work than most professional people.

They accept the requirements of their occupation, appreciate opportunities that are offered, work best with little or no supervision, and resent close control.

They are responsible people.

They respect authority—but only when they feel the man wielding it merits respect. (For example, an engineer or management man with a record of experience, accomplishment or success.)

They command authority from those below them. They do not delegate authority well. They are not too adroit in personnel relations, nor tender of "feelings" when they get in the way of completing the job.

They enjoy working in small groups—on specific projects. They do not like to do a "piece" of many jobs. They are friendly with those in their group; however, they form few close friendships.

Engineers *prefer* methods, objects and processes to either ideas or people.

They value personal rewards and material gain perhaps somewhat more than people in other professions. However, this does not detract from their sense of responsibility or their willingness to work many overtime hours.

They consider themselves ingenious and resourceful thinkers, rather than creative thinkers.

They become tense and irritable when their opinions are ignored.

Their self-control is very strong, however, and they rarely express their inner feelings.

Their standards are high. They have little tolerance for inadequacies on the part of themselves or others. They have an inner fear of failure stronger than is found among members of other professions.

They are constructive in both their occupational relationships and their social and public activities.

Their strongest concerns are family and personal advancement.

They want to build solid, successful careers.

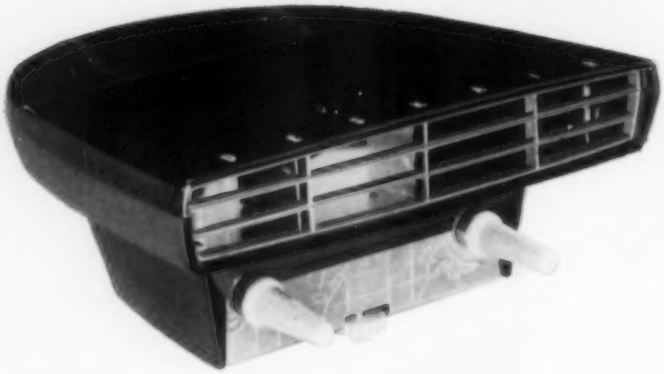
They believe they work harder than non-engineers.

Their professional training is reflected also in their home life. In their personal life, as on the job, they like to plan and work toward a goal or objective.

They are efficient family managers. Cautious, conservative and orderly, they act with energy and competence.

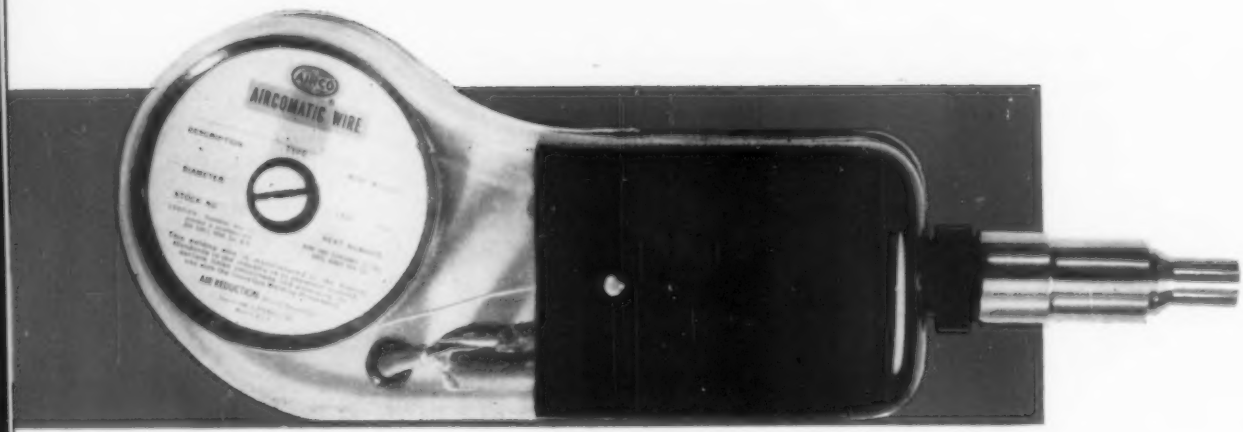
They respond to pressure by putting forth increased effort and perseverance.

They live steady lives, and impart their personal balance to their families. Their marriages are not likely to fail. ■

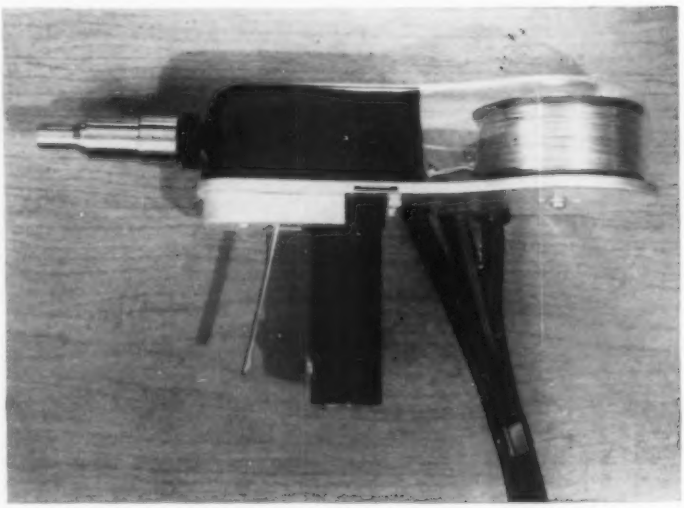


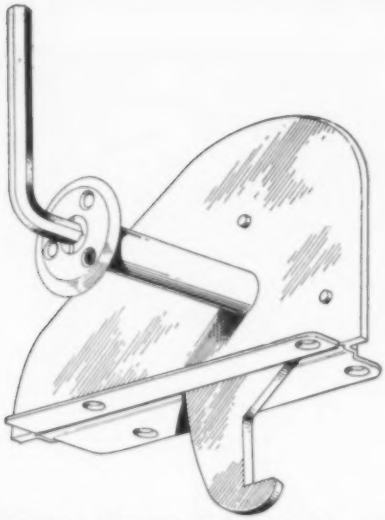
THIS AIR CIRCULATOR directs air stream over desk or table so that loose papers are not disturbed. Horizontal impeller operates at two speeds, selected by knurled knob at right. Plastic wheel centered in base raises or lowers housing. Idea for the design was born when John Wistrand of Creative Dept. at Brown & Bigelow, St. Paul 4, Minn., used a war-surplus horizontal blower to circulate air over his drafting board without disturbing drawings and other papers.

TRENDS in



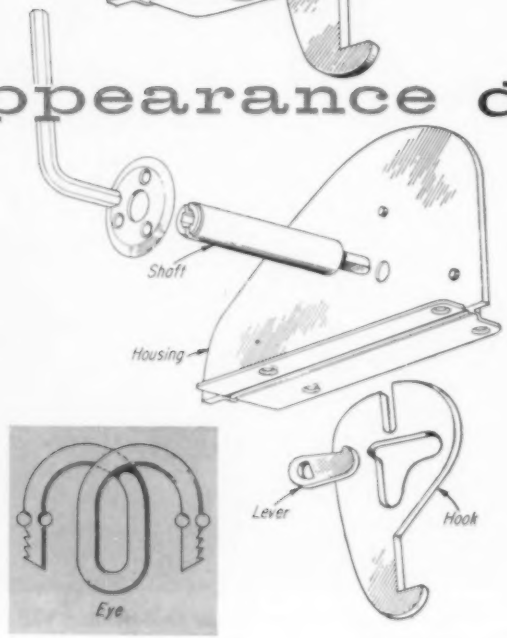
INERT-GAS-SHIELDED WELDING GUN contains own wire supply, drive rolls, and motor (located in handle), weighs only 2¾ lb. and is 14½ in. long, making it particularly suitable for hard-to-get-at places. Curved metal-strip trigger automatically trips gas supply just before closing electrical contact. Comes equipped with separate hand portable control unit and all necessary accessories for welding an assortment of metals, including aluminum, at speeds up to 900 ipm (with wire dia. up to 1/16 in. dia.). Air Reduction Co., New York 17.



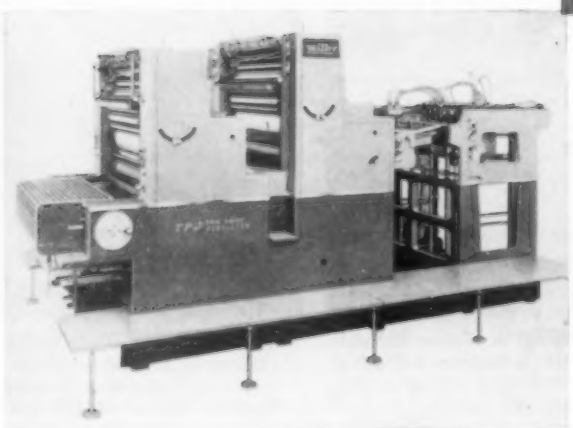


HOOK-AND-EYE CONSTRUCTION FASTENER for assembling insulated panels (3⅝ to 5⅝ in. thick) for refrigerated warehousing had to be capable of being manually locked with a simple tool such as a hex wrench. Once secured, it had to maintain a positive lock until released. Mechanism had to be self-cleaning, so that it could not be made inoperative by mud, snow or ice. Hook and lever had to be replaceable without entirely removing panel from position. Hook cannot accidentally fail to engage eye in adjacent panel, because these members are completely engaged before locking action begins. Hook assembly housing is die-cast aluminum. Developed by Egmont Arens, New York 17, for Quartermaster Research and Engineering Command.

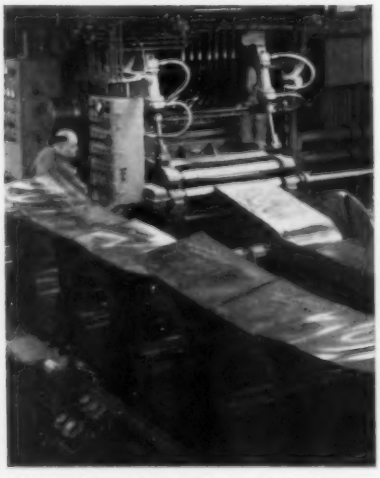
appearance design...



VERTICAL ELEMENTS of two-color offset press (below, left) have been effectively integrated and the top-heavy bulkiness typical of this type of equipment minimized by Peter Muller-Munk Associates, Pittsburgh, for Miller Printing Machinery Co. Both functional and manufacturing considerations were observed in choice and grouping of controls. Optical gage (below, right) is properly clean-lined for use in production shop, and viewing and adjustment elements are effectively arranged. Made by Bausch & Lomb Optical Co., Rochester, N. Y.

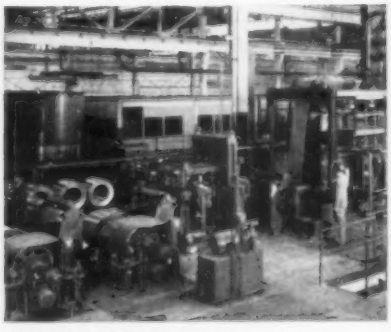


PAIRED FOR PRODUCTION, this tandem 4-High Cold Rolling Mill processes metal bar into workable sheets—operates at higher speeds to match the requirements of other new production machinery.



ONLY ONE OF ITS KIND, this new Chase Mill has the finest electronic and automatic controls available, to assure careful control of surface, gauge and quality.

PRECISION FINISHING of sheet and strip is produced by this Sendzimir Rolling Mill —assures you of highest quality in your own finished products.



KEEPING TEMPER is the assignment of this combination strip cleaning, annealing, pickling and drying-out line in the new Chase production facilities.

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles

NOT EVEN A PIN-HOLE gets by the electronic eye of this quality-control machine. Result—high quality to end costly rejects on your production line.

UNRIVALED SHIPPING *and Handling Facilities* assure quick handling and delivery ready for use. Note care Chase takes in packaging to protect the metal.

Now you get these 5 big advantages from ultra-modern facilities at Chase Brass!

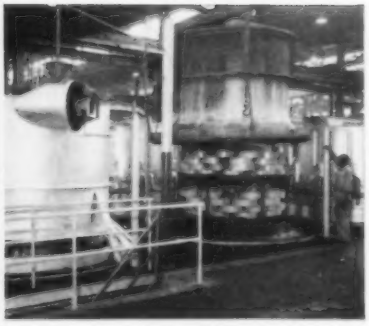
1. You can now buy heavier coils—up to 100 lbs. per inch of width in unwelded brass and up to 180 lbs. per inch of width in copper. Longer coils match requirements of modern high-speed production equipment in your plant.

2. You can count on the best surface ever! Special mills now used are designed to produce unrivaled surface quality in both sheet and strip.

3. You can be sure of maximum gauge control. Ultra-modern electronic and automatic controls protect close-tolerance gauges from end to end of every strip.

4. You're assured better-than-ever annealing! New continuous strip annealing and bell-type annealing furnaces protect grain size and surface quality far better.

5. You can rely on delivery matched to your own production-line requirements! Automation, speeded-up operations, faster output all combine to guarantee quicker quantity deliveries.



OUT OF A PICKLE! Controlled inert gas atmosphere in new bell-type furnaces eliminates need for intermediate pickling.

Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT

Subsidiary of ***Kennecott Copper Corporation***

Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L. I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

Alex Dreier and Walt Behlen, President of Behlen Manufacturing Company, demonstrate the Behlen Powr-Steer to engineers attending the 1958 Design Engineering Show. It is mounted anywhere along the steering shaft and has both right hand and left hand operation. Dimensions: 15½"x4½"x6-9/16".

ALEX DREIER, NBC's "Man On The Go" Reports On The Behlen Hydraulic Servo Mechanism

Part of my job is keeping up with unusual developments in any field. In April I attended the 1958 Design Engineering Show and Conference at the Chicago International Amphitheatre. I was particularly interested in the Power and Control section of this conference, attended by many original equipment manufacturers.

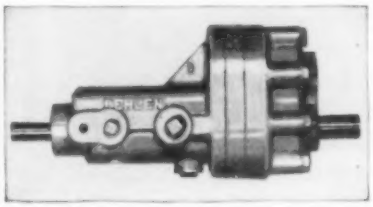
On exhibition here was the Behlen Hydraulic Servo Mechanism, originally known as the Behlen Powr-Steer. This advanced rotary type hydraulic servo mechanism has proved highly successful on thousands of farm tractors. It is a gear-type hydraulic mechanism in contrast to the piston type used on passenger cars and other equipment. The power source is a gear motor that provides continuous 360° turning under full power in either direction.

I found that *this Behlen Hydraulic Servo Mechanism* is capable of almost instantaneous response to the controlling signal. It is actuated by as little as 1 lb. of mechanical force. It also blocks and controls wheel shocks. It does not affect the steering ratio. And by means of mechanical linkage it maintains full and positive control in event of hydraulic power failure.

Behlen was first to offer power steering for row crop tractors, five years ago. For the past two years International Harvester has used it as original equipment on their Farmall 300 and 400 series.

Engineers tell me *the Behlen unit's versatility* suggests it can be easily adapted to many industrial, heavy construction and agricultural equipment applications. And it can be done without drastic and costly engineering changes on production lines.

If you want to see just how easily the mechanism can be applied to your products as original equipment and how it can add a big plus to their sales appeal, get in touch with the Behlen production manager, Howard Christensen. Your request (which will not obligate you in any way) will receive his personal attention.



Behlen Manufacturing Company Dept. PF-6 Columbus, Nebraska

SIGNIFICANT PARTS · MATERIALS · EQUIPMENT

Mechanical indexing table . . .

can be set or adjusted to any index pattern or any number of indexes between max of 24 and min of four. Equipped with an adjusting screw at each station which, when adjusted, will change locked position of any individual station from zero to 15° from its true location. Also equipped with a skip station arrangement that makes it possible to skip one, two, three or five stations each index. Can be obtained for either air or hydraulic operation. Table is now produced in a standard 12-in., 24-station model at $875, FOB Holland. Delivery within 10 days. **Savage Engineering Div., Lithibar Co., 345 W. 14th St., Holland, Mich.**

Circle 11, Reader Service Card

Miniature reflection pickup . . .

is completely self-contained, housing both photo cell and light source in an area of ⅜ x 4 x 1 in. Probe works equally well when light strikes a reflective object or an illuminated area. Lens location provides high reflection of ambient light. Reflection point is adjustable from 2 to 24 in. Spectral sensitivities from infrared to visible green regions are available. Lamp is standard with greater than 5000-hr life expectancy at 5.9 v. May be used with photoelectric controller relays, which operate without tubes or transistors, or with electronic counters or other electronic controllers. Probes are used with control equipment for counting, side web action, register control and positioning of materials. Reflection probes are about $28.00. **Tri-Tronics Co., 2607 St. Charles Rd., Bellwood, Ill.**

Circle 13, Reader Service Card

Motors without cooling fins . . .

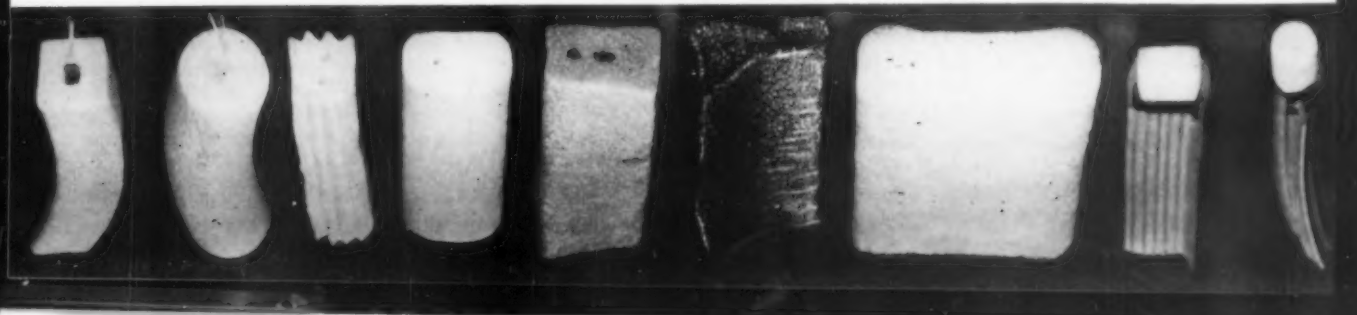
are UL-rated as explosion-proof. Housed in heat-treated aluminum alloy, the motors are approved for Class 1, Group D and Class 2, Groups F & G in NEMA rerated frames 254U to 256U, 284U to 286U and 324U to 326U. Horsepower ranges from 5 to 30, depending on speed. Absence of external, dust-collecting fins makes the motor particularly applicable in dusty or dirty atmospheres of an explosive nature, where accumulation around fins would be dangerous. Alloy aluminum housing is said to provide lighter weight, increased tensile strength, and greater corrosion resistance than conventional materials and designs. Assorted types of connectors available. Offered at no increase in price over standard motors. **Electra Motors, Inc., 1110 N. Lemon St., Anaheim, Calif.**

Circle 12, Reader Service Card

Extruded vinyl foam . . .

in a standard line of round continuous lengths ⅛ to 1 in. dia. (or width) and in formulations and production techniques to produce the foam in a wide range of profiles, colors and with or without reinforcing fibers or conductors. These extrusions have a uniform, small-cell structure, with a controllable mixture of open and closed cells. Compatability, high strength and abrasion resistance suit it for such uses as fillers in extruded shapes, protective packaging, furniture beading, permanent gasketing for industrial users in which flow of the material is desirable. Inherent qualities include flame resistance, high shock absorbency, non-rotting nature, especially when used in conjunction with vinyl films or extruded shapes. Material is said to be priced competitively with other foam extrusions, but less than neoprene and rubber products. **Carolina Industrial Plastics, Essex Wire Corp., 1601 Wall St., Fort Wayne, Ind.**

Circle 14, Reader Service Card



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√ Production possible right away without "tooling-up" first.

√ Easy to alter design or make revisions with no loss to you for costly dies or special tools.

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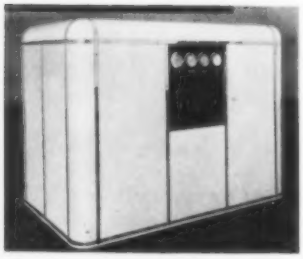
SHELL ASSEMBLY ▶



◀ COMPLETE FINISHED ASSEMBLY ▶

Write for descriptive folder . . . or send single-line drawing for prompt cost estimate.

LINDSAY STRUCTURE DIVISION

INTERNATIONAL STEEL COMPANY

1431 Edgar Street | S | Evansville 7, Indiana

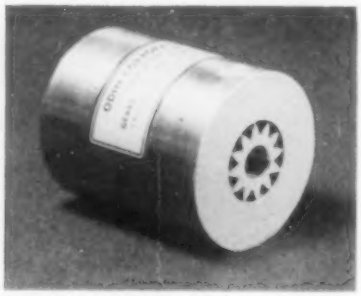
Canadian Affiliate: Lindsay International, Ltd., Port Credit, Ontario

SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

Temperature-sensitive relays . . .

embody a temperature-resistive pellet that changes from a solid to a liquid state at a specified temperature and hermetic sealing, accomplished by bonding metal headers to high-thermal, shock-resistant glass housings. Current ratings are 2, 7.5, 10, 25 and 50 amp. Relays are said to exceed applicable military requirements with temperature sensitivities of 120 to 600 F. Dimensions range from ¼ x 1 in. long to ⅝ x 1.25 in. long, depending on current rating. Applications include overload protection for rotating electrical equipment and fire protection systems. **Networks Electronic Corp., 14806 Oxnard St., Van Nuys, Calif.**

Circle 15, Reader Service Card



Shaft couplings . . .

suitable for diameters from ¼ to 3 in. will disconnect at a predetermined torque figure. Adjustments in torque setting and resetting after disconnection are said to be simple. In normal operation, shaft coupling permits a small shaft misalignment and possesses considerable torsional flexibility. It can be furnished with a microswitch for stopping driving motor, if desired. Larger sizes have a central floating member connecting two splined shaft hubs at ends. Smaller sizes combine floating member with one of the shaft hubs. **Odin Corp., Castleton, Ind.**

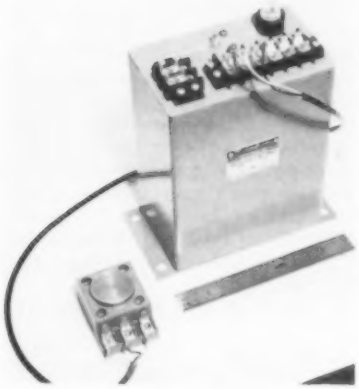
Circle 16, Reader Service Card

Explosive actuator . . .

of the screwed-in dimple motor type has a steel case with a ⅜-24 thread and a 7/16-in. hex. The end of the device is closed with a specially treated copper diaphragm that will extend 1/16 in. upon actuation. Explosive gases are contained within the body of the unit after actuation and, therefore, do not present a hazard to other equipment in the vicinity. Meets environmental requirements of MIL-E-5272A. Can be provided in a wide range of 100% fire and nonfire actuating currents. Ap-

propriate applications include actuating switches and initiating small, longitudinal, mechanical movements. Screw-in design and glass-to-metal sealing make units particularly compatible with electrical or electromechanical systems. Price is about $5, depending on quantity and specification requirements. **Holex, Inc., Hollister, Calif.**

Circle 17, Reader Service Card



Proximity limit switch . . .

is built without moving parts or contacts. Designed to be independent of switching operations performed. Electrical output is 24-v dc at 0.0335 amp, adequate to drive static control elements and 24-v dc relays and solenoids. Consists of an encapsulated sensing element with an open C-core having two windings and a steel-encased control element with balance circuit, amplifier, phase detector, flip-flop circuit, transistor output amplifier and power supply. Installed, sensing element is positioned so ferrous machine part to be detected passes across face of element within trip distance, adjustable between $\frac{1}{8}$ to $\frac{1}{2}$ in., or with a second sensing element, between $\frac{1}{8}$ and 2 in. When magnetic material enters this zone, it causes sensing bridge circuit to be unbalanced, resulting in a signal that is passed to control element, where it is converted into a digital 24-v output for driving subsequent control devices. Power supply is standard 117 v ac. Up to 20 operations per sec are possible. Said to be impervious to shock, vibration, corrosion and humidity. **Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 22.**

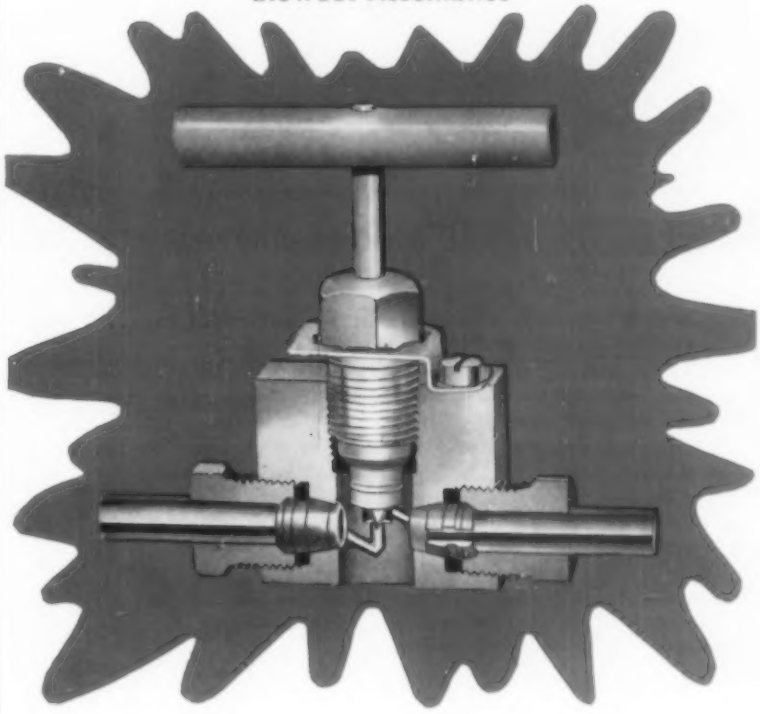
Circle 18, Reader Service Card

Now Available

QUICK-SEAL

VALVES and FITTINGS

Tubing . . . Check Valves . . . Line Filters
Blowout Assemblies



For FAST Assembly HIGH PRESSURE Systems

Pressures to 10,000 p.s.i.

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AMERICAN INSTRUMENT CO., INC.
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completely redesigned

REEVES® *Vari-Speed MOTOR PULLEY*

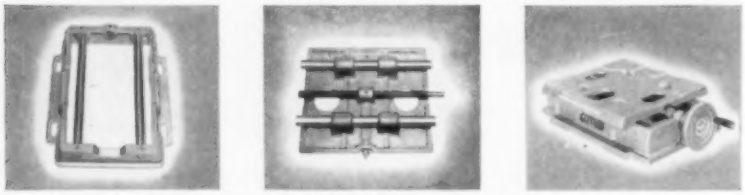
Here is variable speed control in its most simplified form . . . variable speed control with new economy.

Disc assemblies have just three main parts: two smooth-face, cone-shaped discs; and the belt tension spring. There are no other wearing parts to give maintenance trouble. Compact disc assemblies available in nine sizes, ½ hp. through 15 hp., to fit both old and new NEMA motors.

Separately mounted countershaft assemblies are available. For complete information on sizes and available controls, write for Bulletin K36a-V582.

Split section view of sliding disc shows how REEVES "close grooving" maintains film of lubricant between hub length of fixed disc and bore of sliding disc. One lubrication point services entire disc assembly.

New precision bases Four compact sizes to accommodate old and new NEMA motors in ¼ through 15 hp. Sturdy bases are specially manufactured to assure positive, easy adjustment and accurate speed control.



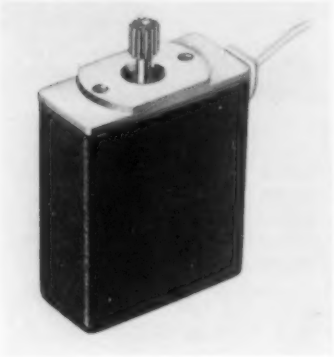
Base and motor slide rods manufactured for precision fit and true alignment. Fully-lubricated shifting screw and precision features provide easy shifting.

REEVES PULLEY COMPANY

Division of **RELIANCE** ELECTRIC AND ENGINEERING CO.

Columbus, Indiana

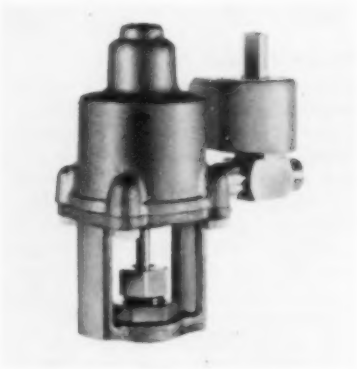
SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .



Rectangular motor . . .

is for applications where space is critical. Designed to military specifications, motor has a symmetrical armature winding, simple construction and good heat dissipation. Also contains double-shielded bearings and Alnico magnets. A typical 27-v dc motor is rated at 13 millihp at 10,300 rpm and 0.8 amp current, continuous duty. Standard units operate in ambient temperatures of −65 to 200 F. Weighs 0.40 lb with explosion-proof enclosure. Various mountings are available. **Barber-Colman Co., Rockford, Ill.**

Circle 19, Reader Service Card

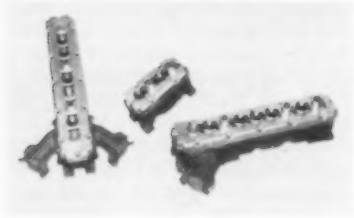


Solenoid-controlled cylinders . . .

for control of heavy-duty levers, latches, dampers and other mechanical motion may also be used as valve actuators. Cylinders are single acting, controlled by a 3-way solenoid valve arranged to alternately apply or vent pressure. Changes in stroke or load in pounds do not affect current in-rush. A 3½-in. size is provided with cast iron frame and top plate, cadmium-plated steel cylinder, stainless steel stem and return spring. Max load at 50 psi is 360 lb. A 2¼-in. size has cast bronze frame and cylinder, stainless steel stem and return spring. Max load at 150 psi is 375 lb.

Suitable for flange mounting, cylinders operate on air, water or oil at pressures from 10 to 150 psi and at any standard ac or dc voltage. **Automatic Switch Co., Florham Park, N. J.**

Circle 20, Reader Service Card



Explosion-proof pushbuttons . . .

are available in two through nine unit stations, both surface and pendant mounting. Cast from aluminum with reinforcing construction. Covers and cases are machined to a metal-to-metal seal required by UL specifications. Stations are offered with pilot lights, selector switches and pushbuttons, single and double circuits with a rating up to 500 v ac. Plugs and receptacles can be mounted on either or both sides of the station. Typical applications for the NEMA 7 explosion-proof pushbutton stations are found in atmospheres where combustible gases are present. **Gemco Electric Co., 25685 W. Eight Mile Rd., Detroit 40.**

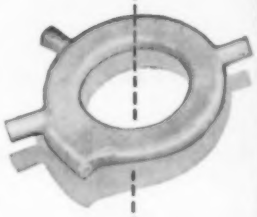
Circle 21, Reader Service Card

Panel display light . . .

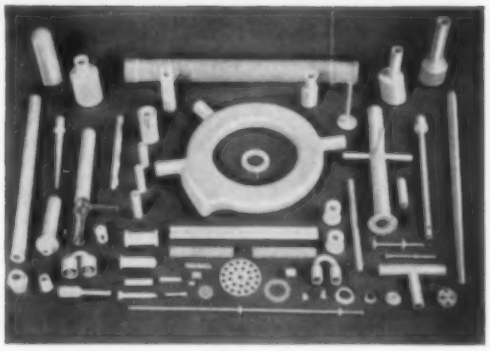
is transistor-equipped and has a body ½ x 1¼ in. long. A 30-sec solderless operation is reported to mount and hook up the unit. Self-contained transistor circuit requires a 3-v signal to control the light. Lamp circuit requires 200 v dc at 0.5 ma. This model requires a positive swing of 1 to 10 v at 25 microamp and a negative swing of 2 v at 100 microamp to illuminate and extinguish. **Transistor Electronics Corp., 3357 Republic Ave., Minneapolis 26.**

Circle 22, Reader Service Card

McDANEL CERAMICS



may be your ANSWER



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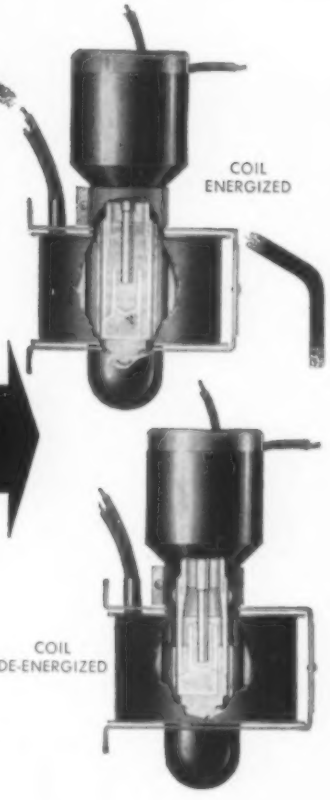
Let us study a sketch of your application. Your inquiry is special to us.

The **TIMER RELAY that handles all controlled timing problems . . .**

★ No false contacts
★ Non sticking
★ Practically "fail safe"
★ Low cost timer



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STEEL MERCURY TIMERS

This steel clad, factory set, tamper proof Durakool timer-relay is practically non-breakable. Operating life multiplied 5 to 6 times by new plunger construction features. Combinations of operate-release time delays from 0.15 sec. to 20 sec.—either normally open or normally closed action.

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NEMA RERATE MOTORS!

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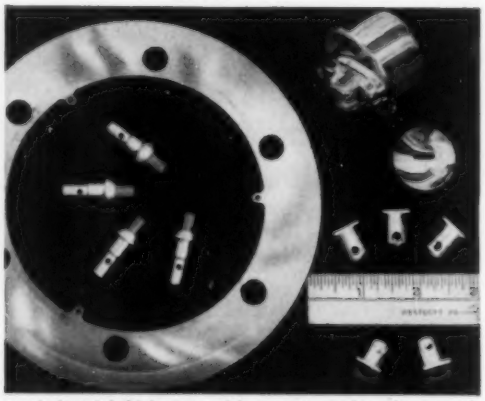

BART specializes in plating to heavy industrial thicknesses with every type of precious metal.

Backed by 44 years of experience and equipped with large modern facilities augmented by one of the most extensive engineering and research organizations in the electroplating field, Bart Manufacturing Corporation can provide an unequalled plating service.

Contact BART today regarding your present precious metal plating problems or future requirements.

GOLD PLATING: Specification plating up to .001 inch with conventional or bright gold over complete surface or on specified areas. Heavier deposits on critical areas can be deposited by use of BART-developed techniques. Piece parts up to 6'0" long can be processed. Complete barrel facilities available for small parts.

SILVER PLATING: Heavy platings running up to ⅛" and more for caustic processing equipment and other uses. Specification platings as under-plating for Gold and Rhodium.

RHODIUM PLATING: Heavy platings to .000150" and heavier for corrosion resistance and wear resistance on contact surfaces.

PALLADIUM PLATING: Heavy platings for corrosion resistance used as a non-tarnishing finish on silver plated waveguides and other electronic components.

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SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

Solid film lubricant . . .

contains a molybdenum disulfide compound that is bonded directly to metal surfaces by a resinous material. Film prevents contact between metal surfaces, providing a low coefficient of friction and eliminating galling, seizing, cold welding and fretting corrosion. Lubricant remains unaffected by humidity or unusual atmospheres, is impervious to oils, greases, solvents, acids, alkalis. **Hohman Plating & Mfg. Co., 814 Vermont Ave., Dayton.**

Circle 23, Reader Service Card

Heat exchangers . . .

are designed to operate under reduced pressure for cooling and heating purposes. These heat transfer surfaces, now in use in the aircraft and electronic industries, are expected to find applications as oil and fuel coolers and in air-to-air, liquid-to-air, liquid-to-liquid, saturated vapor-to-air exchangers, and as evaporators and condensers for compartment cooling. **Tenney Engineering, Inc., Heat Transfer Div., 1090 Springfield Rd., Union, N. J.**

Circle 24, Reader Service Card

Flow indicator . . .

is clearly visible from a distance, because a chromium-plated ring spins within a glass dome with movement that precludes misreading. Variable-flow models can be reset in the field for high or low range and are available with die-cast brass body in ½, ¾ and 1-in. pipe sizes for flows from 0.72 to 24 gpm. Other models are available for flows from 0.075 to 120 gpm in pipe sizes up to 3 in. Useful wherever there is circulating water, oil, or other liquids of similar viscosity. **McIntosh Equipment Corp., Walker Crosweller Div., 15 Park Row, New York 38.**

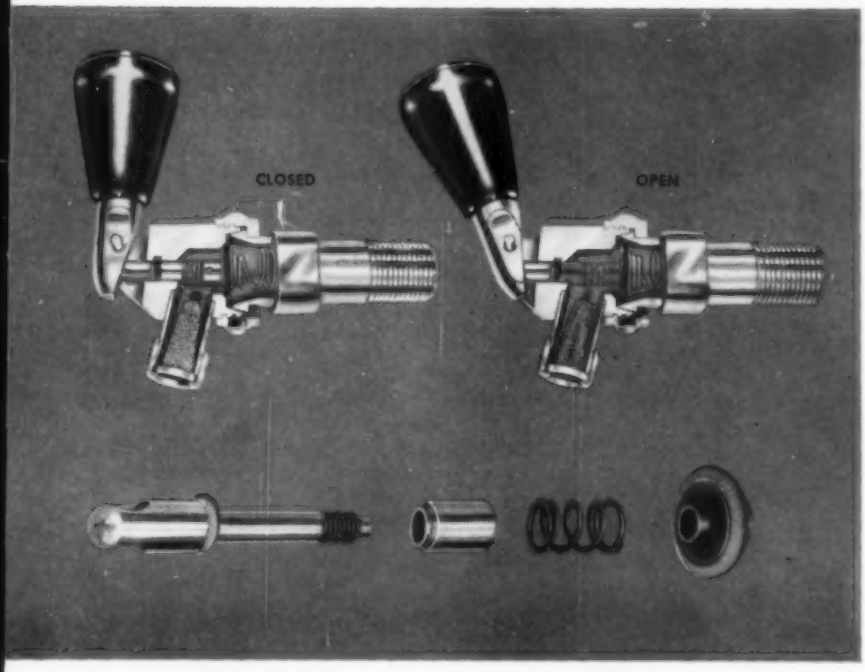
Circle 25, Reader Service Card

DU PONT
Better Things for Better Living ... through Chemistry

PRODUCT ENGINEERING NEWS
LATEST PROPERTY AND APPLICATION DATA ON
TEFLON® TFE-fluorocarbon resins

Redesign of valve stem to use O-rings of TEFLON® widens range of applications of chemical faucet

TFE-fluorocarbon resins



NEW DESIGN, based on the properties of a TEFLON resin, makes this a truly all-around chemical faucet. Valve stem was redesigned to take new seals. The O-rings remain unaffected even when dispensing such highly corrosive liquids as rocket fuels. (Faucet by ECO Engineering Company, Newark, New Jersey; O-rings of TEFLON TFE-fluorocarbon resins by Halogen Insulator & Seal Corporation, Franklin Park, Illinois.)

The ECO chemical faucet had an inherently wide range of uses, because it was made of stainless steel. But certain limitations were imposed by failure of its seals in contact with various corrosives and solvents. A simple design change made it possible to use seals of a TEFLON TFE-fluorocarbon resin, one of the most chemically inert materials known.

The stem was redesigned in such a way as to permit the small O-ring to be mounted without physical deformation by means of a shank sleeve. The larger O-ring is assembled into its groove by an adapter and is allowed to contract in place.

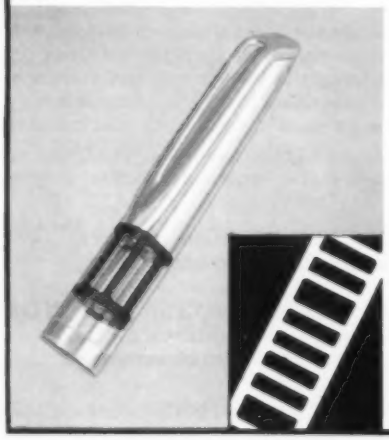
The gains were impressive. Even where highly resistive materials had undergone cracking, discoloration and failure—as in the handling of the rocket fuel hydrazine—TEFLON TFE-fluorocarbon resins showed no sign of change. They are unaffected by heat to 500°F. and do not embrittle even in liquid helium. Due to their extremely low-frictional surface, the seals slide easily . . . never stick. Tight, leak-proof closure is assured.

This is another example of the *right material* for the job . . . plus *good design*. Perhaps you can use a TEFLON resin to to get similar outstanding advantages. Learn what these advantages can be, and receive a technical report on the engineering properties of TEFLON resins by writing to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 36-6-16, Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont Company of Canada (1956) Ltd., P. O. Box 660, Montreal, Quebec.

Liner coated with TEFLON® prevents marring of pen

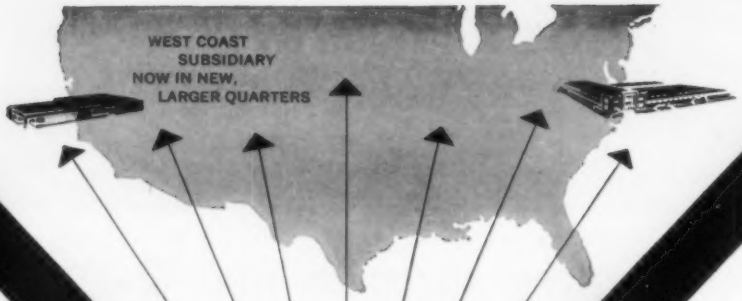
TFE-fluorocarbon resins



Sections of stamped copper strip coated with a TEFLON TFE-fluorocarbon resin are used to line this fountain pen cap. The smooth, low-friction coating makes it easy to slip the cap onto the pen and prevents marring of the ends. The resin protects the spring against corrosion, and its anti-stick properties prevent adhesion of ink. (Made by Waterman Pen Co., Inc., Seymour, Connecticut.)

TEFLON®
is a registered trademark...

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE-fluorocarbon resins discussed herein. This registered trademark should not be used as an adjective to describe any product, nor should it be used in whole, or in part, as a trademark for a product of another concern.



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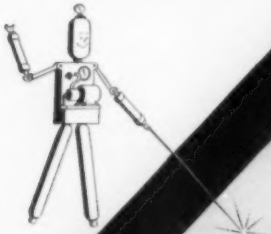

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NEW LITERATURE

Two on Behavior

"Some Applications of Behavioral Research," RENSIS LIKERT and S. P. HAYES, JR. Published by Unesco Publications Center, 801 Third Ave., New York 22. 5¼x8½, 333 pp. $3.25.
"Human Relations in Industrial Research Management," R. T. LIVINGSTON and S. H. MILBERG. Published by Columbia University Press, 2960 Broadway, New York 27. 6x8¾, 418 pp. $8.50.

These two books, both published earlier this year, are devoted to discussions of the problems met when people must work together, particularly in activities emphasizing research and development. Despite similarity of the subject and the fact that both books consist of papers by American authors, neither volume contains any significant reference to the other.

This is not too difficult to understand, when it is realized that the book listed first is primarily concerned with the theory and application of behavioral science (formerly called social psychology but now expanded beyond that older discipline). The Livingston-Milberg book is essentially a collection of the experiences and problems of people closely associated with supervising the work of scientists and engineers.

If the two books are read in the order given above, just about every director of research and development can gain much insight into his own day-to-day administrative problems. Viewed as a discussion of some of the significant sociological tools now available for use in society, *Some Applications of Behavioral Research* can have meaning well beyond the scientific and engineering fields. In the hands of Madison Avenue's "motivational" researchers, the fruits of behavioral science have been given some disturbing connotations and applications. When applied by men such as the authors of the papers included in this Unesco publication, some pressing problems of our society may be at least a little easier to solve.—JK

A Minority as a Source of Engineers

Engineering colleges, industrial concerns, professional societies and Negro engineers themselves were surveyed to determine the training and employment opportunities for members of this minority group. It was concluded that considerably greater opportunities do exist today, and that the problem is to increase the number of Negro youths choosing engineering as a career.

Abstracted from "A Minority Group As A Source of Engineering Manpower," by Robert Kiehl, Newark College of Engineering; Journal of Engineering Education, April, 1958, Prince and Lennon St., Lancaster, Penna.

COLOR TRENDS—Folder, 6 pp, contains chart of trends in public's color preferences from 1933 to present, with 2-yr projection to 1960. Faber Birren & Co., 500 Fifth Ave., New York 36.

Circle 1, Reader Service Card

ALUMINUM FABRICATING FACILITIES—Booklet, 14 pp. Describes engineering services and metalworking tools. Aluminum Co. of America, 739 Alcoa Bldg., Pittsburgh 19.

Circle 2, Reader Service Card

MATERIALS RESEARCH AND MECHANICAL DEVELOPMENT—Report, 16 pp. Presents 18 case histories to demonstrate how materials research and mechanical development advanced performance and reliability of mechanical components, systems and structures. Lessells and Associates, Inc., 916 Commonwealth Ave., Boston 15.

Circle 3, Reader Service Card

ZINC—Book, 96 pp. A revised basic text on zinc, including history, sources, production, significant properties and important applications. Updated to include latest research and production findings. American Zinc Institute, Inc., 60 E. 42nd St., New York 17.

Circle 4, Reader Service Card

INTERNATIONAL NUCLEAR RESEARCH—List of 2500 scientific papers to be presented before 1958 International Conference on Peaceful Uses of Atomic Energy, Sept. 1-13. Atomic Energy Document Service, Chronicle of United Nations Activities, 234 W. 26th St., New York 1.

Circle 5, Reader Service Card

PLATE AND SHEET METAL FABRICATION—Catalog, 12 pp. Describes operations in fabricating field. Items covered include tanks, housings, panel boards, weldments, bases, power plants, machine pans and guard, many applicable to DEM products. Littleford Bros., Inc., 457 E. Pearl St., Cincinnati 2.

Circle 6, Reader Service Card

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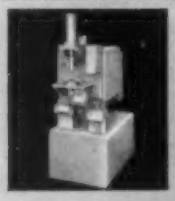
increases motor assembly production rate

Illustrated is PERMAJECTOR Model 150



...with typical tooling for assembling parts and injecting PERMAWICK into sleeve bearing lubrication cavities ... in one automatic operation.

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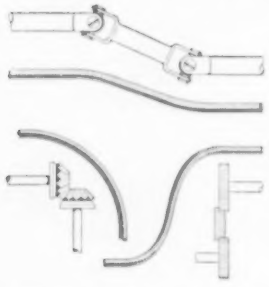
Fluidwick COMPANY

FLEXIBLE SHAFTING REDUCES GEARING



Flexible Shafting reduces the noisy and cumbrous gearing used in conjunction with solid shafts. It has the ability to transfer power from remote places, over, under, and around obstacles found in the path of installation between the drive and the driven units. Flexible Shafting requires very few parts, making them inexpensive; whereas solid shafts using universal joints, miter gears, and gear trains, many times would not be feasible because of their noisiness or lack of economy. With a Flexible Shaft assembly, design may be simplified and your engineering time spent on other necessary component parts without having to worry that they will create obstacles when placed where you want them.

Flexible Shafting cuts down on vibration thus offering long life with very little maintenance required. For complete Flexible Shaft information, write F. W. Stewart Corporation, 4311 Ravenswood Ave., Chicago 13, Illinois.

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Publisher's Postscript...

R & D *marches on*

We have a very active economics department, here at McGraw-Hill, headed up by one of the great thinkers of our times. He doesn't follow the crowd—often his "look ahead", with respect to the business climate we might expect, clashes sharply with the opinions of other economists—but what makes businessmen pay attention to his forecasts, is that he has generally been right. His name is Dexter Keezer, and working with him in his Department of Economics is a group of specialists seldom found in an operation of this kind.

Keezer is a great believer in the basic importance of engineers and research men to our national growth. In his writings and in his speeches, he frequently stresses the vital part played by engineers in developing new products that mean so much to our national growth and our continued prosperity.

He and his group of experts have been reporting to you through these columns, in the fall and again in the spring of each year, exactly what we may expect in the way of future growth of product and research and development activities throughout American Industry.

Keezer has just completed another national survey, as a check on the one he made last fall. One might expect, in the light of some of the industrial gloom spread about in the papers, that R & D activities would contract this year—just as plant expansion has slowed down. But not so. Industry, while curtailing in other directions, is going full steam ahead in developing new products and modernizing old ones.

His report shows that industry will spend 14% more for product research and development this year than last, with a steady increase indicated each year right through to 1961. Keezer reports that industry expects to get 12% of its sales in 1961 from products not made in 1957.

Our Department of Economics has just released a 16-page booklet containing this complete report. It is not a forecast, but an actual report of what companies *now* plan to spend. It covers investment in new plants and facilities, as well as planned expenditures of product research and development. Information is arranged by industry groups so that you can check the rate of your own expenditures with those of your industry.

If you'd like to have a copy of this report, simply write "BUSINESS PLANS" on the reader service card on the facing page, in the space marked "SPECIAL DATA" and mail. Please be sure to include your name and address. A copy will be mailed to you promptly. —AH

74 For Your Information (personal)

Carvable resin

An epoxy resin that "can be readily carved with standard hand tools," and used to fabricate "sturdy but inexpensive models and patterns," as well as for hobby applications is announced by Marblette Corp., 37-31 Thirtieth St., Long Island City 1, N. Y. Known simply as Maraset #611, this resin can be cast in sections up to 2 in. thick, or used as an overlay on wood, metal, or other materials. It cures at room temperature to a Durometer (Shore D) rating of 60-65, is priced at $6 a qt.

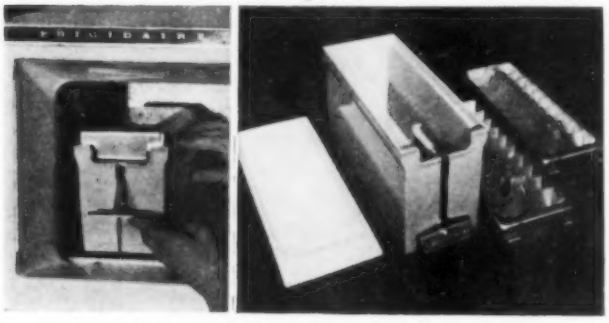
Pumps pick-me-up

It takes a lively minnow to catch a lively fish; and two companies have developed battery-operated gadgets which, they say, are just what a bait fish needs to keep frisky.

One, made by Benesh-Clark Engineering Co., Joplin, Mo., suspends a revolving, ball-tipped plastic cone from a battery-operated motor that sits on top of the bait pail. As the cone revolves, it spins a cooling, aerating jet of water that invigorates the bait. Price: $9.95 (less batteries).

The other midget aerator, somewhat simpler in design, has two flashlight batteries, a motor, and a pump in a separate plastic case. From it runs a flexible tube with a perforated cylindrical tip which is simply dropped into the minnow container. Made by Design Products, Inc., Sarasota, Fla., it's priced at $7.95.

Traveling cubes



A portable ice cube freezer-dispenser, designed by Frigidaire, should be a hot item for the summer picnic days ahead. It also shows what can be done with a few simple parts—just two trays, a bin, and a lever with a plastic (nonsticking) ejector arm. To freeze the cubes, trays are inserted in the unit, right side up. To empty them into the storage space beneath, a tray is inverted (it fits in the slots at the top of the bin), the handle is depressed, and the lever arm, engaging the movable grid (also a new design) in the tray, turns the cubes out.

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NEW LITERATURE

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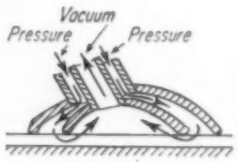
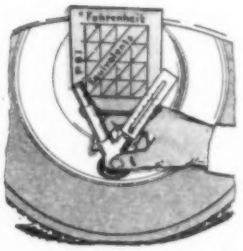
WHY DON'T THEY RESEARCH and DEVELOP . . .



. . . a vacuum cleaner that is not limited to atmospheric pressure. A maximum pressure differential of 14.7 psi is hardly adequate for some industrial applications. How about applying a positive pressure adjacent to the suction entrance? It might operate off the same motor and require very little redesign of current models. —C. McLaughlin

. . . an instant hot water tablet. It would be sold with instant coffee and tea and would give off enough heat, when moistened, to boil a cup of water. A waterproof coating or bag might be necessary to prevent accidental wetting. —C. Van Tassel



. . . an air pressure gage for auto tires, that would compensate for temperature? A temperature-sensing element could be connected through a linkage to a scale on which pressure is indicated, corrected to a standard temperature, say 100 F. Air pressure could then be adjusted to a safe level regardless of actual tire temperature. —H. A. Woodle, Jr.

. . . a magnetic transcription system to record color slides for projection through a television set. A 35mm slide could be replaced by a disk or plate with magnetized spots carrying full picture information. Drop the disk into an appropriate slot and see your favorite slide without projection, screen or dimmed lights. —Dr. Saxe Dobrin

. . . a method for embossing meaningful safety warnings into road surfaces. Ridges are already used to warn motorists of steep grades and high speeds. A properly spaced set of ridges should be able to shout "Slow down" or "Stop" or even "LOOK OUT!" —M. E. Parker

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

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WARNER

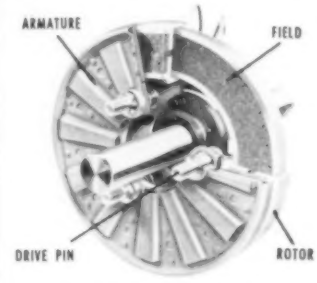
electric motion control **FACTS**

for IDEA MEN

Electric motion control simplifies design of pushbutton paver

An electrical control system, made possible by versatile Warner electric brakes and clutches, not only permitted a clean, uncluttered design of the drive for this bituminous paver, but also made control of the heavy, rugged machinery a fast, fingertip operation.

Instead of the multiplicity of levers and foot pedals commonly associated with similar equipment, the operator merely manipulates fast-acting toggle switches. Benefits include easier, more automatic operation and improved work quality.



Stationary-Field Electric Clutch

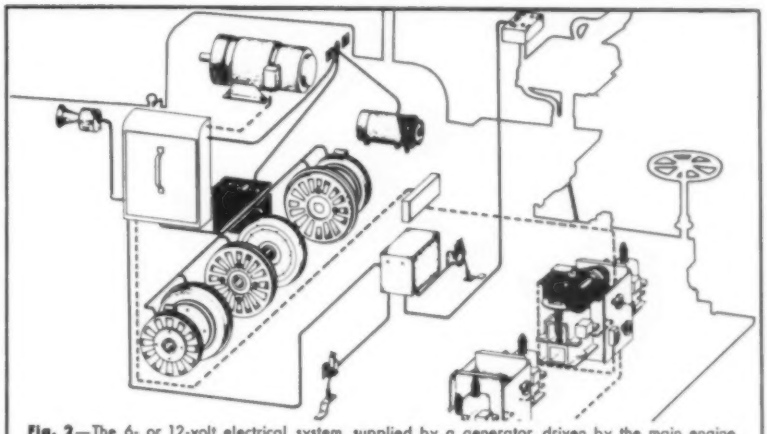


Fig. 2—The 6- or 12-volt electrical system, supplied by a generator driven by the main engine, controls the clutches and brakes for the crawlers, the slat-feed conveyors, and spreading screws. It prevents operation of the conveyors and screws in reverse gears, controls the automatic system, and powers the engine starter and lights.

Number of wearing parts reduced

Maintenance, a factor that can make or break profits on construction work, has proved to be one of the strong points of the electrically controlled machine. A complete teardown after almost a thousand hours showed nothing but normal wear on the Warner brakes and clutches.

And the new design has eliminated a number of wearing parts, such as chains, drive shafts, and universal joints. Only six chains and two V-belts are required for the power drive system, whereas other systems often require as many as 17 chains and ten V-belts.

New clutch design increases dependability

Use of the Warner Integral Horsepower design gives added assurance against maintenance cost and work delays. Slip rings and brushes are not required for the stationary fields of these clutches. Wear surfaces can be replaced without disturbing the electrical connections. Flux flows from the coil through the intermediate member, or rotor, into the armature. Thus, wear is confined to the faces of the rotor and armature, either of which can be replaced quickly and easily.

Superiority of this design is attested by the dependable, instantaneous clutching of the crawler. Steering clutches engage in approximately four milliseconds—one reason wear is considerably less than on slower acting competitive clutches. These improved Warner units can be substituted for collector-ring types with little or no design change. If you want to eliminate electrical maintenance, ask your Warner field engineer about the new powerful Integral Horsepower brakes and clutches.

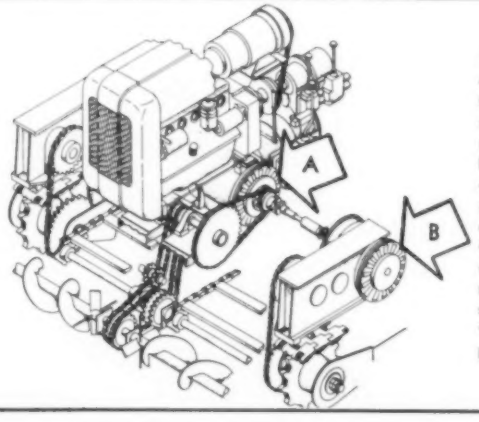


Fig. 1—Two sets of Warner electric clutches (A) control the slat-feed conveyors and spreading screws for each side of the paver. Four heavy-duty, stationary-field electric clutches and replaceable-face electric brakes (B) operate the crawler drive. Crawler clutches are in constant use for steering. Positive no-slip engagement and instant response help eliminate wear and maintenance problems.

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